CAST

DisCovery Amplification Sustainability and InTeractions

cast

WICASTR
Engaging Wireless Experiences. Everywhere.

MEDIA INNOVATION STUDIO

IMPACT HUB

uclan
University of Central Lancashire

Team

Clare Cook, Principal Investigator, University of Central Lancashire, UK
Dr Mark Lochrie, Creative Technologist, University of Central Lancashire, UK
Onno Piet Guy Baudouin, Senior Creative Technologist, University of Central Lancashire, UK
Morgan Hollett, Media officer, University of Central Lancashire, UK
Debbie Dearnley, Project Coordinator, University of Central Lancashire, UK
Armine Saidi, CEO WICASTR™ SMART Edge Platform
David Esteves, CTO WICASTR™ SMART Edge Platform
Gor Hovsepyan, Senior Wireless Expert, WICASTR™ SMART Edge Platform
Artak Babayan, Technician WICASTR™ SMART Edge Platform
Sara Anjargolian, Co-founder / CEO, Impact Hub Yerevan
Ani Baboomian, Programmes and Events Manager, Impact Hub Yerevan
Lusine Gevorgyan, Community Outreach, Impact Hub Yerevan
Nune Harutyunyan, Project Internship, Impact Hub Yerevan

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University of Central Lancashire, Preston, UK

Authors

Clare Cook
Onno Piet Guy Baudouin
Mark Lochrie
Armine Saidi

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FOREWORD

The creation, broadcasting and discovery of relevant information is one of the pressing concerns of the 21st century. Globally, there is a growing interest from policy makers, content creators and technology providers for the provision of alternative, decentralised technology infrastructure and democratic channels that can challenge the powerhouse gatekeepers of the Internet. Communities need new ways to create and share stories about their local life to enhance community connectivity. More too needs to be done to ensure media plurality and balance. Publishers need ever more accurate data analytics about what is being consumed by whom when where and why. And the advent of smart technologies and connected objects requires more knowledge about decentralised data capture and edge computing. However research tells us that a number of challenges stand in the way of truly ubiquitous access and retrieval of content.

Therefore, a step change is needed to meet the system requirements of millions of communities world wide – in the countryside and emerging territories - that are without reliable access to the Internet or have to pay a premium via mobile data charges. Innovation is fundamental in order to answer the growing trends in mobile and multimedia consumption of content, as well as the importance of online and digital tools in making local, relevant and socially valuable information accessible, and 'findable', to audiences. CAST aims to drive this forward by testing a new way to amplify independently produced information that would otherwise be drowned out by the 'noise' of the Internet. It does this by prototyping a lightweight community connectivity system capable of hyperlocal content distribution.

INTRODUCTION

CAST has trialled a new community communication network in rural Armenia developing models to emerge alternative news media in a highly politically pressured national state. The project was a collaboration between the Media Innovation Studio, UK, Impact Hub Yerevan and SMART Edge Platform provider WICASTR™, Yerevan. The project also ran with the support of the United Nations Development Programme, award-winning investigative journalism outlet Hetq, and Civilnet from the Civilitas Foundation. It was a three-phase year-long pilot that ran in 2016 and 2017, funded by the UK Higher Education Innovation Fund.

Decentralised wifi infrastructure

CAST has developed and deployed a community connectivity system in three remote villages in Armenia: Lernapat, Kamaris and Ltchashen. The lightweight system used stand alone broadcasting devices to serve news and information to mobile phones via WiFi without the need for an application. Online content was adapted as static pages served and distributed as offline content in hyperlocal locations such as bus stops, health centres or village buildings.

Digital community connectivity

Content was provided on the CAST system in three main ways and distributed from 26 devices:
1. Aggregated content via automated scraping from independent or alternative online news services including the European Union, ArmComedy, Hetq.am, Kolba.am, UNDP.org, Civilnet and Arm Weekly News. This was served as offline static pages and appears as .in feeds in our analysis.
2. A content management system (CMS) which was edited by members of the village community. Wordpress was chosen as the CMS as it allowed approved users (teachers, healthcare workers, school groups) to manually upload content on village affairs. These posts are .be in our analysis.
3. A peer - to - wall messaging service known as a noticeboard was attempted, where anyone in the community could post short updates from their mobile phone when connected to the CAST network.

Place-based journalism

CAST is designed to overcome a central problem: many people want to find out information about where they are and what is around them via their mobile phone or digital device, but they struggle to discover that content. They want to read their local blogger but find he is drowned out by the hectic and noisy online Google search-driven place of the Internet. They are at the local bus stop and want to know about the church service times, or when the post office is open but have no mobile data coverage. They are at a concert and want to interact with all the other people at the concert, without having to use Facebook. Others might need valuable business or medical services but can't access the Internet because the network has been damaged or shut down. It demonstrates a model for place-based journalism - where content provision could be tailored to the place where it will be encountered - that would give information providers a major technological and social edge.

Proximity data insights

The decentralised typology of CAST allowed us to pinpoint to the nearest meter what news content is consumed where by who: invaluable information for publishers battling to find viable new business models. This precision of news data consumption has not been available to publishers before.

Digital literacy

Members of the community were encouraged to be involved with the production of content to be distributed hyperlocally. They were able to edit a CMS Wordpress site where posts about village life and interests could be shared. Digital literacy was improved through training and discussions, and by older members experimenting with WiFi typologies.

A real-world solution to poor connectivity

CAST has been trialled ahead of the curve: when fully operational, one device can connect to the Internet which receives real-time content and information that can then be distributed amongst all other devices in an offline mode within its network via a mesh formation. This overcomes the problem of communities being cut off from broader Internet access. As an alternative way to achieve media plurality and generate community communications, it is a real-world solution to information access where Internet connectivity is problematic, limited or costly.

This report presents the empirical findings of the first field trial of the CAST prototype. It sets out our approach and explains how we built an online to offline network and why. It then presents early findings on proximity insights: what data we captured and how that data was processed. We present key learnings from the project offering suggestions for future iterations. It situates CAST in a number of research fields including place-based journalism, hyperlocal publishing, information communication systems, media plurality and digital literacy. It draws into focus the potential and limitations of a village connectivity system aimed at enhancing the discoverability of alternative news and information.

CAST - The Aim

- Build a lightweight community connectivity system for content distribution
- Generate proximity insights: new data analytics that allow publishers to pinpoint what content is consumed where
- Facilitate novel approaches to digital literacy by creating engaged digital communities

Hyperlocal refers here to particularly small or rural communities. Hyperlocal distribution is achieved as users access content within a few meters of devices in pinpointed localities.

We trial a decentralised communication system capable of serving and analysing content based on location.

We move towards place-based journalism which explores how news and information from a range of content providers could be distributed according to place.

Proximity Insights are a new form of media data analytics presented here. They offer new data based on place-based content consumption mapped to very small distances.

Media plurality refers to news and information that represent a variety of viewpoints which add to the diversity of content normally accessed by a community.

Digital literacy is the capacity and competencies to participate in a knowledge society. Of particular interest is the ability of a range of users within rural communities to access and engage with new digital collaborative communication tools.

Sara Anjargolian, CEO Impact Hub Yerevan, 2017:
"Often in the regions even if people have the latest greatest phones people don't usually enable 3G. It is so experimental and that is what is most exciting about it. If we can get to a place where we are bringing connectivity to villages who wouldn't otherwise that is a pretty cool result."

"I can't believe that geolocated news delivery based on where you are doesn't exist – for you to be more informed about where you are. This has to change."
Alexis Madrigal Silicon Valley Bureau Chief Fusion, SxSw 2015

New knowledge and impact have been created around:

- How to build hyperlocal proximity networks using online to offline wifi technology
- Future scoping information systems for remote communities
- New hyperlocal news data analytics for publishers
- Novel methods to add to media plurality in a highly politically pressured environment
- Strategies to improve digital literacy and community communication that can challenge a digital divide

SUMMARY

How to build hyperlocal distribution networks

The village connectivity system operated across 26 devices in three villages. Locations included schools, healthcare centres, bus stops and village meeting spots. A two-phase approach to software development was carried out including one phase of rapid build. The structure of the system was iterated three times to enable efficiency and scale. This proximity network is an alternative way to achieve hyperlocal distribution. This further helped impact on the technology readiness of technology partner Wicastr ™.

Data as a transfer process between online to offline news content

Content was transferred from online sites following automated really simple syndication scraping and converted to static pages. Having a local copy and WiFi hotspots allowed users to connect via WiFi without the requirement of having a data plan on their device. This differs from other beacon or application-based systems where the online connectivity relies on the user rather than the hotspot.

Proximity insights

Hyperlocal analytics on usage collected per device in the village has never before been available to publishers in such detail. These analytics are presented here as proximity insights. Understanding the data generated from interacting with content furthers the understanding of news content that communities want, where and when. The devices can also capture real world metrics of how many people there are with smart devices in a proximity (when WiFi and bluetooth are enabled on the device). This data significantly furthers our understanding of place-based journalism.

Media plurality

Content was scraped from seven sites which were selected for their work producing independent quality news as alternative to state-owned media. Content was carefully selected to offer communities the opportunity to read and interact with media that added to the diversity of viewpoints they would normally access. In total between June -December 4938 articles were served, 520 videos, and 12,521 images totally 22GB of data. Understanding the way villagers interacted with the system (what was viewed, downloaded, how many times, how long you stay connected) is key to understanding the connection with complex media plurality issues: what communities want, where and when.

Digital community connectivity system

Members of the community were encouraged to edit content and write to a CMS Wordpress site where posts about village life and interests could be shared. Overall activity to the CMS hosting hyperlocal content performed better than scraped content from news providers. Total hits to the three CMS village .be sites was 950 representing 55.75% of the total activity compared to 754 .in hits to sites scraped from news providers representing 44.25%.

Digital literacy

More than a dozen training initiatives were delivered across the project to community members of all ages. Digital literacy was improved by encouraging people to write about their village and by older members experimenting with WiFi typologies. Lernapat (population of 2,000) engaged 12 authors and 3 editors to the site. They published more than 70 articles in categories about their village culture and sports. Kamaris and Ltchashen engaged 5 editors each.

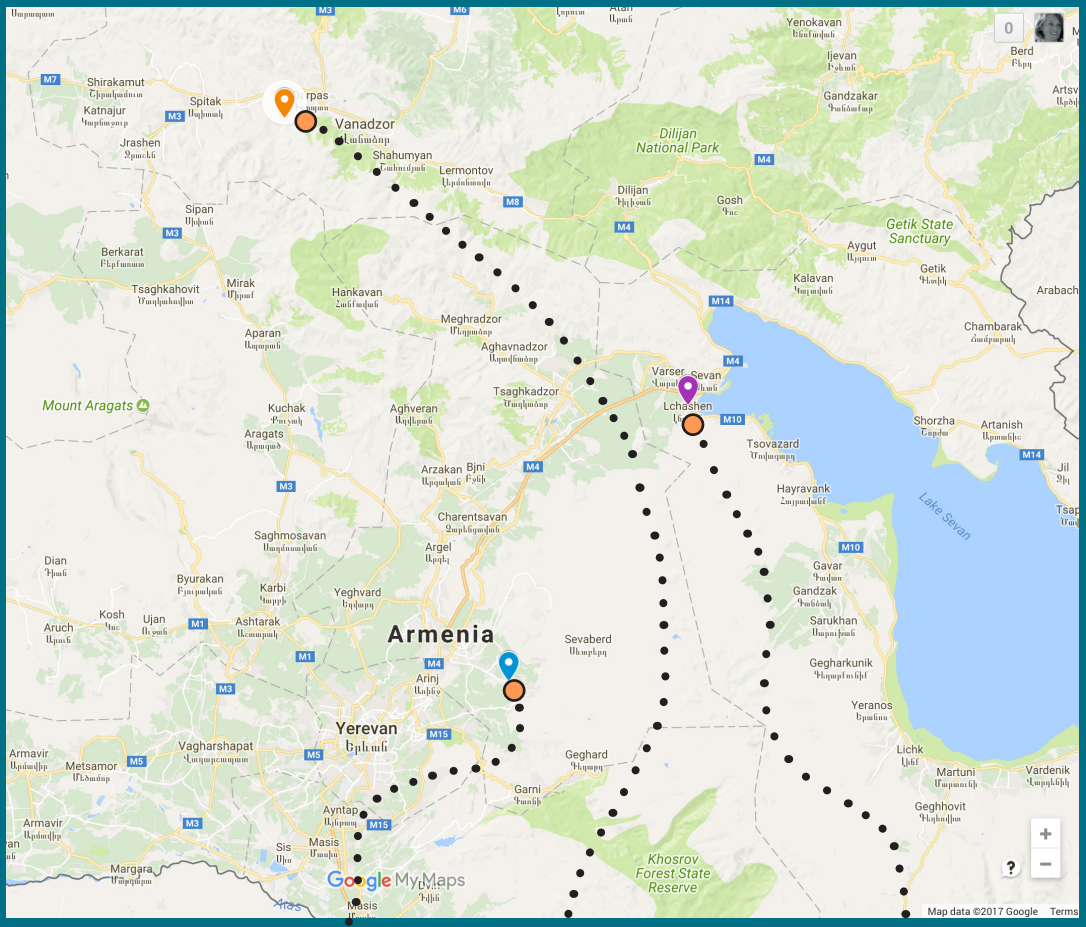
Operations

While Armenia's capital and popular tourist destinations boast ubiquitous mobile connectivity, the quality of service is limited outside of Yerevan. Many villages have only one or two mobile broadband services. We sought villages for project inclusion which were largely cut off from technological advances and where connectivity problems were associated with inadequate and or inconsistent coverage by one or more of the main local telecommunication companies: Beeline, Ucom or Vivacell. We also sought communities keen to be involved in development projects. Impact Hub Yerevan used their local on-the-ground knowledge and initial scoping visits to establish connections. Three villages were selected to offer a comparison. However the data and analysis focuses on two villages: Kamaris and Lernapat. It was decided to exclude Ltchashen in the findings as, towards the end of the pilot, insufficient data connectivity or engagement had been established.

The project began in December 2015 with three live pilot phases: March 15 – June 15 2016, July 4-October 4 2016, and November 28 2016-January 15 2017. The project closed in April 2017. The live phases were used for village visits, training, content production and dissemination, technology maintenance and development. 26 devices were installed and connected to the Internet using Vivacell SIM cards. Having WiFi hotspots allowed users to connect without the requirement of having a data plan on their device.

WiCastr hardware devices were installed in locations according to local advice.

DEPLOYMENT VILLAGES



KAMARIS

LERNAPAT

LTCHASHEN

Kamaris

Of the three villages selected for inclusion in the project Kamaris was the closest to the capital, situated 30 minutes away from Yerevan. With a population of 2,000 and approximately 500 houses it benefitted from reasonable infrastructure including roads, a local shop, library, a health-care point with a doctor and nurse, a cultural meeting house, a kindergarten and post office. The school for 300 children lacked heating and was in poor condition.

The unemployment rate was high with construction and agriculture the main work for people in the village (men mostly). Women mainly stayed at home and there was limited entertainment for young people. Initial meetings were well received and with the backing of local major Narineh Geghamyan, the community were keen to learn more about the possibilities for CAST.

Internet access was available in most homes on desktop computers. The school had one computer room with one Internet connected computer, via cable, and eight machines. The cost of the Internet per month was between 5,500 to 8,000 AMD (€9.8 - €14) which is considered high for the villagers. Most people had smart phones, many Samsung models, without data connectivity. The use of messaging services such as WhatsApp or email was rare compared to phone calls.

CAST had potential to:

- Provide videos and films as offline alternatives to mobile data plans
- As a source of community digital entertainment
- As a way to create a digital alternative to physical bulletin boards
- For information on private bus times as there was no way of knowing when the bus into neighbouring villages and Yerevan would arrive
- To provide entertainment and information at the six bus stops as people wait more than an hour
- To provide news while people wait in the health-care point
- To let people in the village know when medical supplies and medication have arrived and are ready
- To advise on waiting times for medical care

Ltchashen

Under the guidance of the mayor and local members of the government, Ltchashen was keen to trial CAST across the village which included a village hall, post office, health care point, school, market, two libraries, a milk production factory and bus stops. An hour from Yerevan, Ltchashen presented a particular challenge as the village is spread across 225 hectares with a population of 4,000, 800 of whom were under the age of 15. Many women were out of work after a carpet factory closed.

The village did not have any WiFi and Internet was restricted to domestic settings. 90% of young people had smart phones but no data connections due to cost, between 6,000 and 8,000 AMD (€10-€14).

CAST had the potential to:

- Provide information on smart screens in the village hall
- As an alternative to Facebook at village level
- For women to learn new skills
- To share announcements

Temperatures of -30C and building access complicated installation of WiCastr hardware.

Lernapat




The team visited the Municipality in February 2016 and introduced the project to the mayor and blogger Tatev Abazyan. The village was set high in the mountains more than two hours away from Yerevan, with a total population of 2165 people, 426 aged from 6 to 16 years old. The children took part in a vibrant wiki club, translating and updating content and the school has one computer room with five machines. The main activity was farming.

The village was hit by an earthquake in 1988 so they built a new area called "new village" which is far from the "old village" by 5-6 kilometers, and people constantly move from old to new and back, since the school and municipality are in the new part but most of the people still live in the old part. Buses serve Vanadzor city and back 3-4 times a day. They had a post office (in the same building as the municipality), school, kindergarten, milk factory, health care point, 5-6 shops, and there was a hall in the municipality building which held the events.

Internet was available at home via modems and considered reasonable at 3,000 AMD (€5). Around 50% had smartphones, but very few had data connection. People mainly had desktops at home. There was also a computer room at school.

CAST had potential to:

- For the school and 218 students to share documents, resources and activities. Homework is often limited to translation activities so offer alternatives to this
- Information around subsistence farming
- As a digital bulletin board and peer to wall application
- Help people learn new languages
- For health-care professionals to promote vaccinations
- To share video and media at two main bus stops, where people gather and hang out not for buses but to drink and talk

Erik, student Lernapat:

"I would like to be lawyer so I can do something useful for my village. The internet connectivity could be improved. It is not very advanced and there is not a lot of technology here. We have WiFi and modems at home but a village wide network could make everything better."

Needs Analysis

At project inception, three focus groups were conducted with school children to establish need. A further nine interviews were carried out with villagers, ranging from a teacher, local councillor, nurse, student and an agronomist. These were an opportunity to explore feedback in more detail: in Lernapat five interviews and two focus groups were held of around 30 villagers and in Kamaris four interviews and three focus groups (total 50 people). A total of 34 village visits were carried out by the team against three main activity types: explanation and training, technical requirements, feedback and review.

Activity	Location	Date	Total visits
Set up, training, feedback and technical	Kamaris, Ltchashen, Lernapat	Janaury 2016-January 2017	34
Visiting Village (1st visit, meeting the mayor and going through research questions)	Kamaris, Ltchashen, Lernapat	Jan-Feb 2016	3
Meetings, demonstrations, explanations and project introductions	Kamaris, Ltchashen, Lernapat	March 2016	3
Installation and commissioning of devices	Kamaris, Ltchashen, Lernapat	April 2016	3
Installation and commissioning of devices	Kamaris, Ltchashen, Lernapat	April 2016	3
Registering authors. Training and presentations on how to be a local journalist	Kamaris, Ltchashen, Lernapat	May-July 2016	4
Installation and commissioning of devices	Kamaris, Ltchashen, Lernapat	June 2016	9

Table 1: Shows total project team activity

CAST set out to respond to initial scoping and feedback:

- Smartphones were predominantly old models with small screens for which drop down menus were hard to navigate
- Instagram and Twitter were not used widely
- Most homes had Internet access via a slow cable connection
- Schools had few computers and limited Internet connectivity
- Identifying where to put WICASTR™ devices was highly dependent on local knowledge as the most popular places were otherwise unidentifiable such as rocks, disused containers or areas of shade.
- Many older people gathered to play games such as backgammon and chess
- Young people were very internationally aware with a keen interest in international media such as Facebook
- Popular activities online included football statistic websites, games, weather, listening to music and streaming videos, Skype calls and search
- Slow speeds for email drive users back to social networks such as Facebook, Odnoklassniki (ok.ru)
- For news, respondents relied on Armenian television in the evenings such as Lratvakan.am, Armenian Haykakan TV (haykakantv.com), and Shant TV.
- Online news sites such as News.am, (168.am) 168 hours news and analysis site and Armsport.am were used along with buy and sell site List.am
- Printed newspapers were accessible from local cities such as Vanadzor or weekly newspapers such as Lori province.
- Kimono.am was popular for films
- Hyperlocal news was mainly distributed by word of mouth. A Facebook group existed for Ltchashen villagers.
- Topic interests included wrestling, wine making, recipes and psychology tests, volleyball

Content Providers

Content was made available on the devices in two main ways: aggregated scraping from news and information sites and on a CMS Wordpress blog produced in the villages by community members.

Aggregated scraping

The content available on CAST was carefully selected to offer media plurality. We set out to offer a sample of viewpoints or content that was alternative to the communities usual sources of information, namely mainstream television. Content was scraped from seven sites which were selected for their work producing independent quality news as alternative to state-owned media or information that had a civic focus. This aggregated content was pushed to devices following automated really simple syndication scraping and conversion to static pages. In total between June -December 2016: 4938 articles were served, 520 videos, and 12,521 images totally 22GB of data. Wikimedia was provided as an offline static resource on the devices.

The content sources were:

Delegation of the European Union to Armenia Newsletter (eunewsletter.am) features information about the economy, human rights and politics. Posts included updates about Armenia's border crossings, new policies and schemes.

ArmComedy (ArmComedy.com) is a satirical comedy show and website which reports events in an original and alternative way. It is written and hosted by Armenian comedians Narek Margaryan and Sergey Sargsyan

KolbaLab (Kolba.am) is a community of thinkers and innovators addressing social challenges. The website hosts features and projects identifying real user needs. The team are keen to face social issues head on with innovative solutions to improving life in Armenia and often actively seek input. They hosted #innov4dev a competition for innovative ideas in Armenia's public sector.

United Nations Development Programme (UNDP.org) features news and analysis from 170 countries and territories around climate and disaster resilience, sustainability, eradication of poverty and the reduction of inequalities. It focuses on sharing solutions on the empowerment of women, the protection of human rights through global debate, measurement tools and policy proposals.

Arm Weekly News (Armweeklynews.am) is a news blog run by five editors to provide news and analysis from around the world to Armenians and the diaspora. The site presents several articles critical of the government with a daily audience of around 2,000. Editor Tatev Abazyan said: "The website, compared with traditional media, presents alternative viewpoints and is online. We gladly provided the information base in Armenian to CAST program by providing a fresh and objective information to populations vulnerable communities."

Hetq (Hetq.am) has a growing international reputation for investigative journalism. Hetq online has been published in Yerevan since 2001 by the Association of Investigative Journalists NGO and publishes in both English and Armenian. Since 2008, it has published daily with support from the journalism department at Yerevan State university. In 2004, Hetq won an award for work against corruption. Hetq has a growing reputation for working as part of investigative teams.

Civilnet (Civilnet.am) is a project of the Civilitas Foundation program which aims to support strengthening of Armenia's statehood and the welfare of its citizens. The site promotes and supports innovative ideas and initiatives. According to Seda Gregory a Civilnet journalist, it is the most 'independent outlet in Armenia' as funding is mainly from grants. The Foundation says "Access to reliable, comprehensive information is essential for democratic development and economic prosperity. Civilnet.am is founded on the premise that it's possible to provide news, in context, well researched, and interesting. The video programming on topics ignored by the mainstream media – environmental issues, women's rights, the activities and interests of the young professional generation, students and their passions, artists and their creativity. Interviews with international figures offer a better understanding of global and regional events and their impact on Armenia."

Community Blog

A Wordpress blogging platform was made available to villagers so they could play an active role in the project. Wordpress was chosen as it allowed approved users such as teachers and project advocates to post and edit stories about their village life and chose a range of categories in order to organise them. Each village was given a My Village page. The stories ranged from local culture and heritage to photographs. Project resources were also hosted here. The aim was to build sustainability into the project by using simple-to-use tools and for the community to have some ownership by playing a role in setting the news agenda and by selecting what type of stories to cover. This was only available within the village. However in the iterated build of the CAST structure we took into consideration that one village could need or want to post to other village sites. The team built a peer-to-wall messaging system which let any users post to a noticeboard with their mobile device when in proximity of a device. It allowed users to upload short updates such as road closures or job alerts. Little data is available from the noticeboard as it remained in beta throughout the project.

Armenian news landscape

Civil and political rights organisation Freedom House describes Armenia's press as being not free under a semi-consolidated authoritarian regime. Its democracy score is 5.9 out of 7 (Freedom House 2017). Editorial independence is affected by pressure from Armenia's political and business leaders. The government exercises considerable control over the views of public media leading to self censorship born from concern over reprisals for criticism of the government or prominent public figures (Freedom House 2016). Demonstrating the lack of independence, a daily political talk show was removed in December 2016 as it featured a controversial interview with political satirist Sergey Danielyan that criticised the ruling Republican Party Of Armenia (epress.am 2017). In 2015 Armenia drew negative attention from the international community for relations over free speech when there were clashes between journalists and the police over electricity price protests. Again in 2016, Armenian authorities were condemned for violence against journalists during a series of stand offs and tension, during which Facebook was briefly restricted.

Evidence suggests serious shortcomings in governance and electoral process. These were in part played out in the run up to the country's first parliamentary election in April 2017 which saw unprecedented levels of manipulation online with coordinated bots spreading misinformation and thwarted narratives on Twitter. Several editors, well known journalists and political analysts had accounts suspended (Khana 2017).

However the country's independent media rating has improved due to increased professionalism, diversity and 'accessibility of Internet media which is challenging the dominance of television as the main source of information' (Freedom House 2017). And it is against this backdrop which CAST aimed to play a part. Journalists have more freedom to report online and a growing number of platforms support diverse analysis and investigative reporting. Moreover the past two years have seen increased diversity in civil society in both numbers of organisations and their diversity. There were more than 5,500 registered organisations as of December 2015 compared to 4,600 in 2013 (USAID 2016). Although television continues to dominate the media scene, Internet media have been growing in influence. Another contributing factor to the Internet's increasing influence is the overall low level of trust towards TV as a reliable source of information. The most recent Caucasus Barometer by the Caucasus Research Resource Center shows that only 15 percent of the population believes that TV channels in Armenia inform the population "well" or "very well". According to the same study, around a quarter of respondents thought that TV journalists were serving the interests of the people, slightly less than the overall level of trust towards media in general. However, still only a quarter of Internet users utilize the Internet primarily for seeking news (CRRC 2016). Armenia's Internet service provision lacks market competition as four operators control 95% of the broadband Internet market, thus resulting in patchy connectivity in remote locations where coverage is most costly to provide (Hergnyan 2016).

"Internet media is challenging the dominance of television as the main source of information and it is against this backdrop that CAST aimed to play a part".

Research Context

Location interplays with journalism in many dimensions. It has long been a building block of story function: location is where something happens, and as a way of defining a news patch or story relevance to audience. Location can be a way of defining a community. The connection of geographic space with place-based knowledge can be an organising or a search tool based on how close the news is such as Foursquare or Google maps. Location can also be driven by positioning technology: beacons, apps and WiFi are three modes of serving content to mobile phones based on place. Yet despite the intense fascination with mobile technology, there is much that remains unknown about the interplay between location and news, even less about location and media plurality. Studies are only now emerging that explore cultural diversity in mobile news consumption preferences (Open Society Foundation 2014).

Locational data derived from mobile devices are also key to media companies' capacity to track online news users' preferences and to deliver them targeted products, services, and advertising. According to the Pew Research Center, the complexities of mobile media development and delivery mean "even the weakest of the tech giants is in a far stronger financial and technological position to develop those [analytical] abilities than all but the largest news organizations" (Pew 2013). A significant research study based in Australia, Mobile Internet Research, has set out to find out more: "Locative news is surely a new way of marshalling, mediating, and making sense of place; evidenced in the new kinds of information created through projects of emplacement, and by the movement in and through places by objects, technologies, and users" (Goggin et al 2015)

Location as a boundary

Newsrooms have long interpreted place as a way to define news patches based on geographic locations such as towns, and more recently hyperlocal areas. A large Destination Local programme by UK charity Nesta explored hyperlocal as a geographic construct or set of niche topics, and funded several research projects around analytics, location-based technologies, revenues and web-based ventures.

CAST is relevant to practitioners exploring hyperlocal journalism as it explores news provision in "a narrow geographical area or set of topics seeking to find a niche, often participatory, among the service gaps left by other available media" (Kurplus et al 2010)

Geolocation

Location as function has been given a dramatic twist with the advent of locative, mobile media. Newsrooms have used place-based mobile applications predominantly to deliver traffic information and weather reports in terms of geolocation (Schmitz Weiss 2013). Some media companies are beginning to experiment with the key capabilities of location awareness. UK hyperlocal project Visit Horsham uses a responsive mobile design powered by Dest-API for a cross platform html5 application to offer location aware news information and offers including a hyperlocal business directory (Cook et al 2016).

Technology as proximity: beacons and apps

Studies around the interplay between place and space have largely been conducted as interactive design experiments in museums (Schmitz Weiss 2013, 2014). Research from the Media Innovation Studio includes locative audio work that brings together artists, designers, technologists and the community of content creators to describe the events of World War I through the voices of families and soldiers. Homing is a locative-based audio navigation experience using beacons designed to bridge the physical gap between story and place to encourage visitors to explore these stories by visiting the Harris Museum Roll of Honour and War Memorial (Southern et al 2016). Another research study at The Old Apple Tree Festival served festival content at six tablet computers via an app to 115 people to measure involvement (despite distractions around them), social facilitation (want to share their experiences with the app generating social facilitation capital) and satisfaction experiments (worth their time and would like to try something like that again) as relevant to place. They found that physical nearness to a point-position seemed to matter and could be understood as a promising component of consideration in terms of creating more efficient effective media objects (Oppegaard and Rabby 2016).

In 2009 researchers in Norway made a medium design called LocaNews, and tested it out with pre-planned procedures to test the interplay of

location on production and reception. Of those who participated, 12 people worked as journalists, editors, technicians, and they generated 93 journalistic stories that were read and watched by 32 test-users who were interviewed. The main mechanism for location function was cartography - where user locates a story based on clicking a map. Of particular interest for CAST is the formulation of news criteria that focus on spatial proximity instead of temporal actuality. Researchers found that it was very difficult to write for location rather than temporal actuality (Nyre et al 2012). More recently beacons have been used to deliver news, for example in a Google Digital News Initiative project based in Manchester, UK. OtherWorld.io uses beacon technology in 10 city locations to create location-based storytelling experiences, helping people to explore the world around them. It uses Bluetooth technology to send stories direct to your phone when you walk near a device, once your phone has been set up. It is hoped that CAST can offer an innovative way to explore how storytelling could be shaped by location as little work has been done as yet to develop journalists' abilities to engage citizens or create innovative storytelling forms based on location (Westlund 2013, 2014).

Technology as proximity: WiFi

According to Westlund (2013) using technology to lead news customisation is a more contemporary practise. More specifically CAST is an example of what he describes as machine-led repurposing, using a CMS to repurpose content across a number of platforms. While wireless has been presented in many cases as an equitable access offering in developing regions (Pascual 2007) these are largely concerned with establishing Internet connectivity at large rather than lightweight online to offline systems. See for example in Peru, WiFi is used to provide Internet health and agricultural services in Amazonia (EHAS 2017) and Huaral (Belo 2014). In Nigeria, Fantsuam Foundation (2017) has deployed an integrated rural ISP linking local partners in the Kafanchan area to the Internet for sustainable community owned networks via Zittnet. Guifi.net in Spain has connected over 4000 nodes including municipalities in Catalunya. Battery Operated Systems for Community Outreach provide access in refugee camps in Gulu, Uganda and programmes merging infrastructure and digital literacy (BOSCO-Uganda 2017). The information communication development projects mostly focus on creating emergency networks in crisis, remote or refugee situations such as with Meshpoint, Net point or Vodafone Instant Networks (Vodafone 2017). Wifi devices have been developed for such deployment such as Brck, with free public WiFi Moja (Brck 2017).

Technology for digital literacy

There has been a growth of research into technology use and requirements in the developing world driven to some extent by product saturation in the developing world. These are placed within the computer human interaction (CHI) and information communication for development (ICT4D) fields. One project, Storybank in rural India, explored mobile image and audiovisual storytelling tools for sharing in a one month trial with 10 customised camera phones (Frohlich et al 2009) . Such projects explore web tools like wiki and weblogs that support new forms of production which turn users from passive consumers to active producers of user generated content (O'Reilly 2005). Others focus on information computer technology for digital inclusion. For example Madon et al (2009) apply institution theory to explore whether digital inclusion projects are sustainable over the long term, proposing this will only happen if they are institutionalised. CAST adds to these fields with empirical data on digital literacy and ICTs in rural communities. It goes further by also presenting early scoping on the potential of the system to act as a mechanism to offer plurality in what news and information is amplified to rural communities.

Building hyperlocal networks using online to offline wifi technology

Content management system

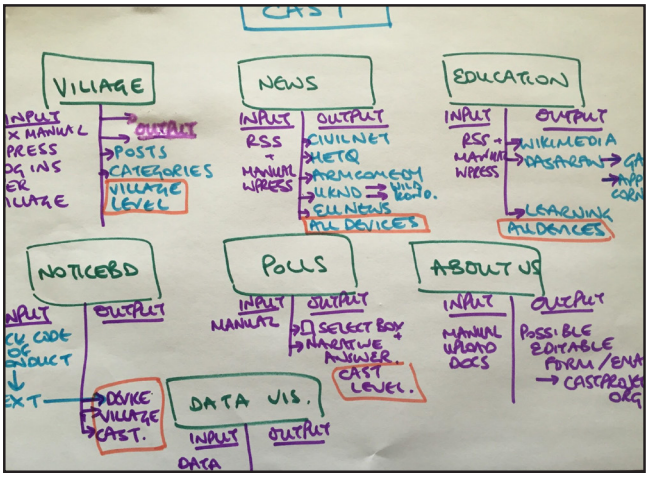
One of the main founding purposes of the CAST project was to allow citizens the ability to access information in a low latency, lightweight way to reduce the burden of cost and connectivity requirements. We also set out to offer an open source, easy-to-use system capable of generating static pages. As such, a CMS based on a word processor was adopted to deliver a simplistic and easy approach to permit the sharing of information. The chosen CMS in this case was Wordpress (WP) for its ability to reskin through themes and add additional features through open source plugins. Due to the nature of the project and the physical infrastructure of the network (low latency, lightweight and self contained) installing a full instance of WP along with a database on each individual box would require a greater load on the network. This is where the plugin feature allows for the WP instance to create static pages of content (simple HTML pages) delivered to the boxes. Through a specific synchronisation method, only new pages are downloaded to each box when a change happens.

Members of the community were shown how to report stories

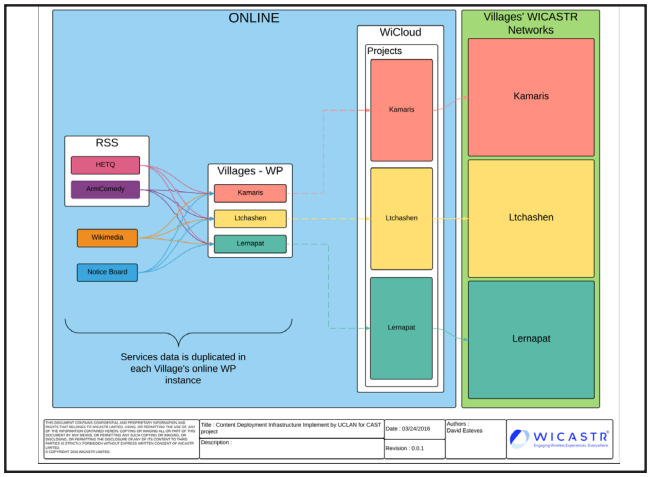
Ecosystem

Furthermore, the WICASTR™ SMART Edge Platform allows for other services to be bundled up with each install similar to mobile ecosystems of app stores work. These services can be hyperlinked to the main WP instance to feel like it's part of the same system. Building on top of the WP instance meant that some services would require the use of the WP in order to serve content into the WP database, for example this was the case when the platform required to pull in content from other providers through an RSS feed. This feed came into the system from seven news organisations and was represented firstly as posts within the WP system. In order to meet the main principle of the system an additional method for sharing information was adopted as a standalone service. The WP instances were available for specific authorised users. These were users who had an Internet connection and were identified as users who we could trust to share information like; a teacher, a nurse, a government representative etc. However over time it was felt that a standalone RSS feed was required generating its own content and database for this type of content. Moreover, the second phase of development generated a richer application- based system capable of scale which reduced duplication and load on the system. The iterated build had other villages, communities, or refugee camps in mind where apps could be drawn in and selected to form a bespoke CAST offering.

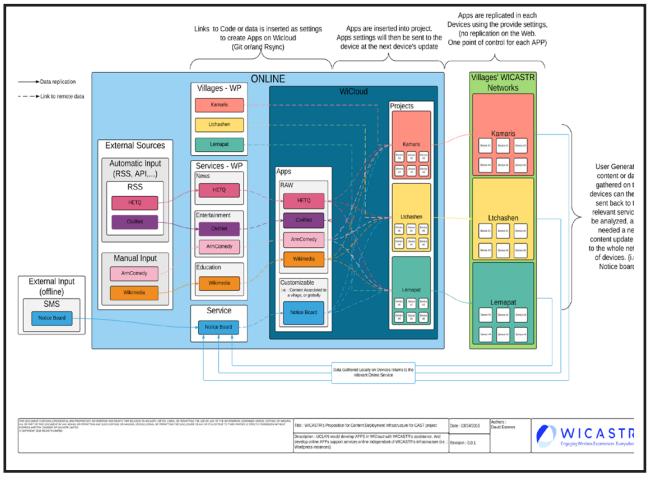
Early brainstorms envisaged inputs and outputs via application features



CAST 1.0 was built with three WP instances one for each village duplicating static pages from each content provider. This system would have been difficult to scale.



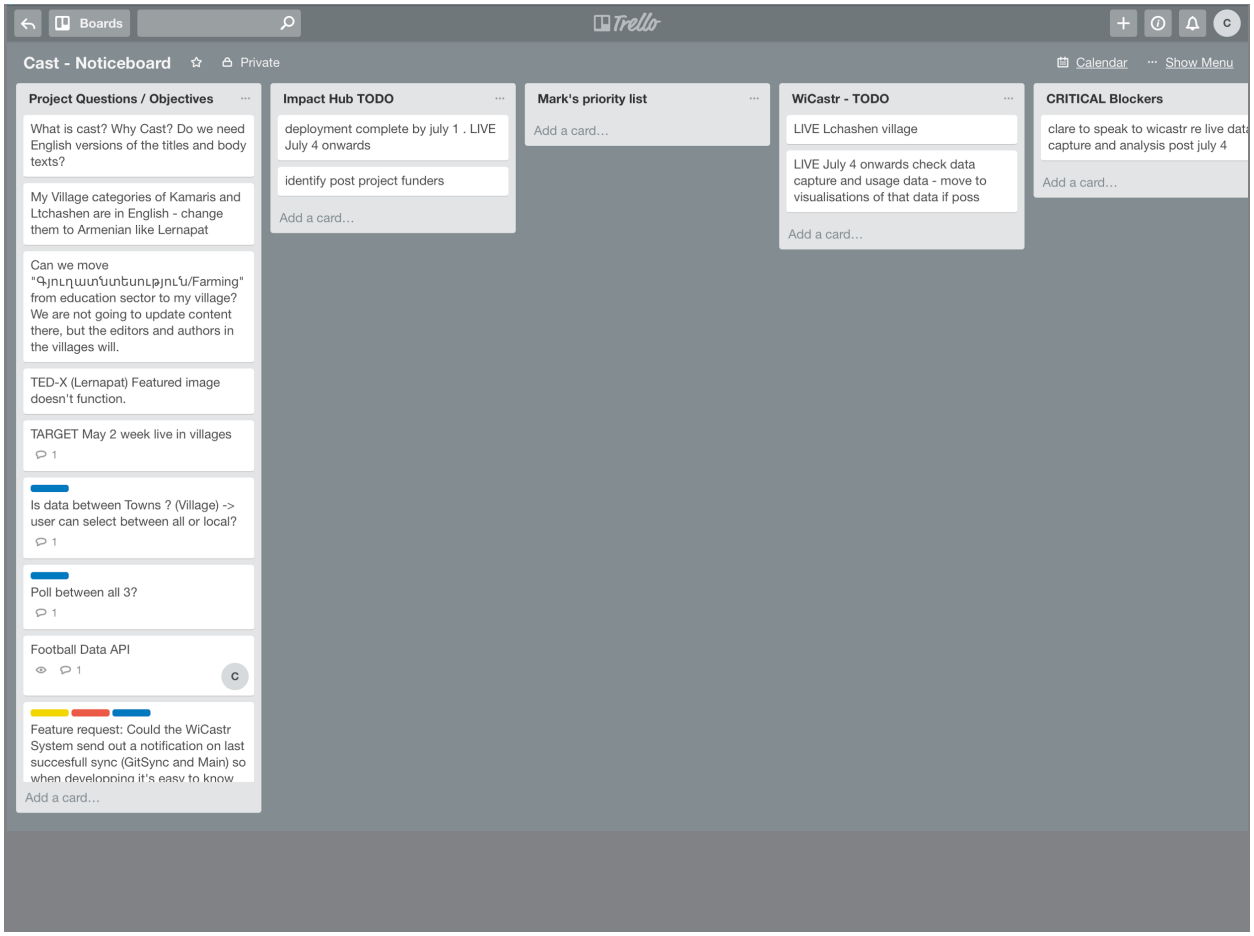
CAST 2.0 was built to accommodate three WP instances of village .be sites alongside a distinct WP instance for each content provider. This prevented duplication and increased the systems agility to distinguish content to device. It also allowed for data gathered on devices to be gathered on location and pushed back to the online service to be redistributed - a key element of the noticeboard structure



Noticeboard

During the trial, it was important to include all citizens in the project by offering any user the possibility to upload content from their mobile phone when connected to a device. This was the main reason for creating a noticeboard. The board allowed anyone who had access, the ability to share text information such as the late running of a bus or a recent change. This area of the system was highlighted for its potential misuse. To keep barriers to entry low, no sign in was required, but the user had to fill in specific areas of the form in order for it to appear on the system. Regulating the content was placed on the users of the system pre moderation, as first and foremost the content resided on the device and was then uploaded once a stable connection was present.

We envisaged a noticeboard where simple content could be created by residents about topics they felt might be of interest to others. Additionally, this content could be targeted not strictly thematically but also geographically: village wide, cross village or even more specific. Unlike all other apps who solely served up static, pre-rendered content, the noticeboard had to store / accept data from the residents on the local access point, and then when internet was available post this out to be spread across the system. Unfortunately, the 'mesh' capability of WiCastr could not be used due to limited coverage.
The team, with a short and intensive development sprint with developers from WiCastr created a fully functional prototype, running on actual devices not on location. However, the nature of the app required both security permissions to be set on database files and 'cronjobs' to be installed on each device separately. Neither of these were supported automatically by the WiCastr system. In effect although the individual devices capable, the distribution process could not cope enough to be rolled out.From a technical perspective the notice board 'app' was a set of PHP files and SQLite database that ran on the local devices' webserver as a separate domain – so it could easily be linked from other parts of the project. Villagers would add content that would be stored initially just locally (and displayed back), and periodically that data would be pushed to the online WordPress instances, which were already used to generate all the content for the rest of the project. The WordPress REST API was used for this, for which WiCastr provided an update to their WordPress online provisioning.



The international team of developers used team working application Trello and Slack to assign tasks as part of rapid development phases

Proximity Insights

The contextual awareness capabilities of emerging mobile technologies are expanding the realm of journalistic distribution by growing digital tethers to place, and emerging new knowledge about use of news and information according to place. These evolving complexities include heightened possibilities for news providers to make connections to contemporary audiences through the customisation of content based on user location. Where a community member is located when media is delivered can matter greatly.

CAST allowed for metadata to be sorted in to hyperlocal analytics on content usage collected per device in the village. In terms of such tailoring CAST presents novel insights for publishers. This approach presents alternative news data analytics to global technology giants such as Google analytics as it has the potential to enlighten impact on key factors such as engagement, social facilitation and satisfaction or demand of users based on hyperlocality. This empirical research has allowed for new knowledge around:

- Insights into consumption measurement and forecasting which are more accurate and based on hyperlocality
- What content was accessed when and where based on hyperlocal proximity
- The possibility of decentralised data capture at the network edge
- How we can measure more accurately media consumption in the digital and social media landscape
- How data can be used from proximity news consumption to drive editorial decision making
- Measuring audience behaviour and engagement on mobile devices

There are three types of data that were gathered.

• Usage data: once visitors were connected to a device or network, data is captured on what is viewed, downloaded, how many times, how long you stay connected etc. Data generated from interacting with the content is used to generate trends and usage patterns, so that the system can identify how to better deliver the content people want.

• Real world metrics: the devices can capture how many people there are with smart devices in a proximity, where they are, where they go (tracking movement, both indoor and outdoors). This happens when WiFi and Bluetooth are enabled on your device, without them being connected to a WICASTR™ device or network. This data is anonymous. Data generated from interacting with the content is only used to generate trends and usage patterns. This function can be fully disabled.

• Personal data: the CAST system can be used to log personal data as part of the experience (such as editing tools like Wiki pages or peer to wall messaging). Once registered the activity on the device can be attributed to the MAC (Media Access Control) address. This data would allow for attribution of identity and associate activities and local content browsing habits to them.

Data processing

Bespoke coding tools were needed to process the data as pre-existing systems could not take into account the specific factors of the data. In total, 269,836 calls were originally logged to the devices. However once duplicates, foreign IPs, invalid requests and other errors were accounted for the total sample of usable data was reduced first to 120,077 original hits and then to a restricted set n= 1,704. (see figure 1). This represents individual content web pages rather than individual elements such as images. In this way n is the sample of true hits by villagers to actual content pages on the devices allowing for grounded decisions on data consumption. Where two devices were in close proximity the results have been combined for clarity. Moving from the original to the restricted data set cuts out the probability of the data being skewed by activities such as installation or testing. Of the restricted visitors sample, the data can be divided to village level hits: Kamaris 1236 and Lernapat 468.

In the villages, the most popular operating system was Android and the most common browser was Chrome (see figure 3).

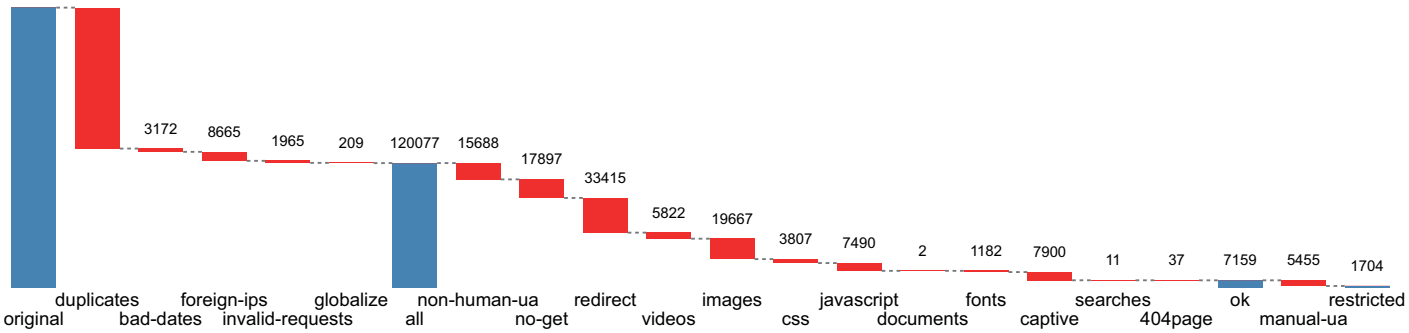


Figure 1: The data processing waterfall shows total original dataset and the reasons for data exclusion towards the restricted data used in the report analysis

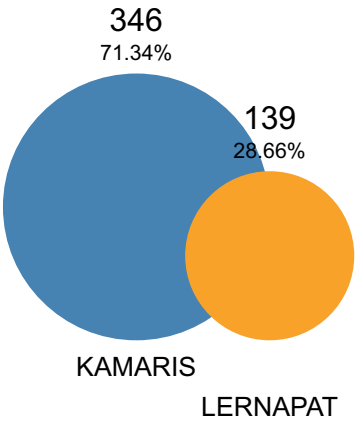
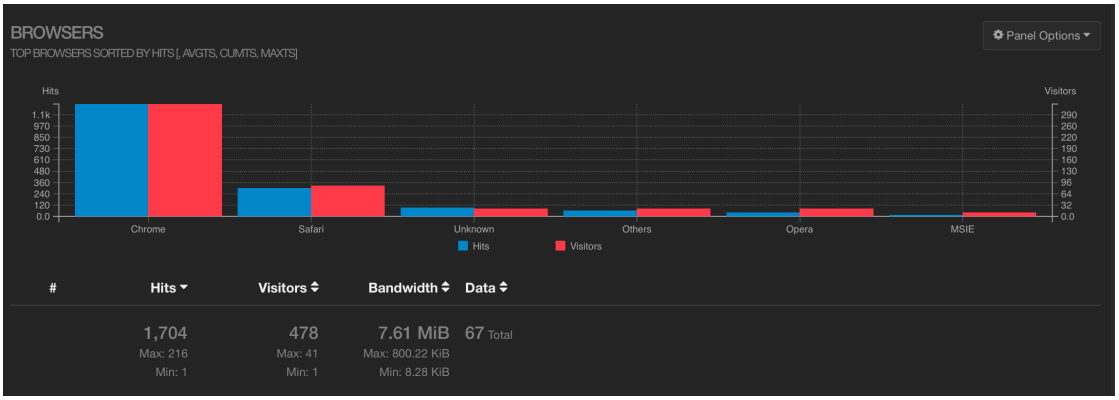


Figure 2: Total hits divided between village activity, to scale



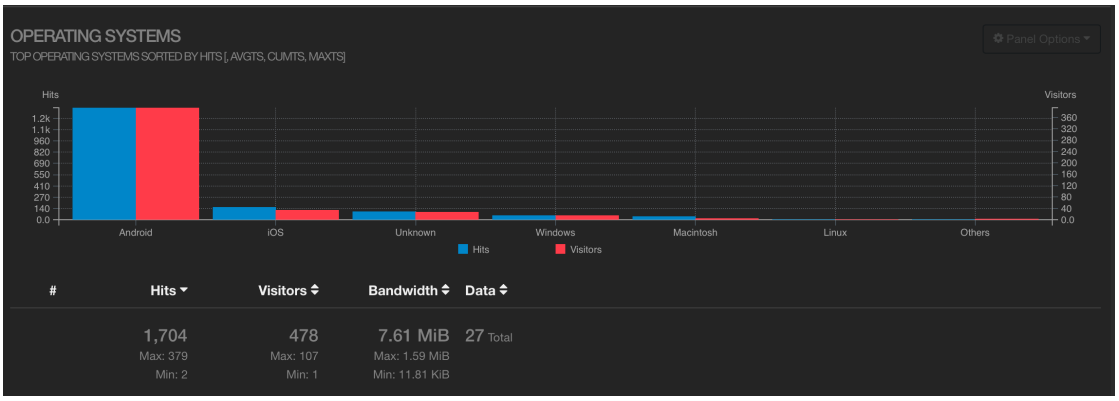


Figure 3: Browser and operating systems data from the restricted hits sample

Content activity based on hyperlocality

Understanding the way villagers interacted with the system (what was viewed, downloaded, how many times) is an important new step to further understanding media engagement: what communities want, where and when hyperlocally. It paves the way to adapt content to where a particular media audience is. For example, how media messages could be adapted to situations so as to generate more engaging experiences.

A unique feature of the CAST system was to allow for analytics based on where content was consumed to the nearest few meters of an installed device. This differs from Google analytics which restricts usage data to town or postcode, and offers limited information in areas such as Armenia. While the sample is small, it acts as a demonstrator for alternative news analytics capable of informing and driving editorial decisions in new ways. This new information could in turn be used to drive revenues by pinpointing popular content to place.

Of the total restricted data set activity it is possible to see in figure 4 where most hits came from in Kamaris (blue) and Lernapat (yellow).

Most activity took place at Narine House device compared to Hangout Square in Lernapat which was the least (see figure 5).

From the restricted data it is possible to see total activity over the project timeline. This can be divided into activity per month and location with the spikes in activity around October and January in Kamaris. (see figure 6).

Further analysis allows for the restricted hits per device to be plotted against time showing which devices had peaks in activity when (see figure 7).

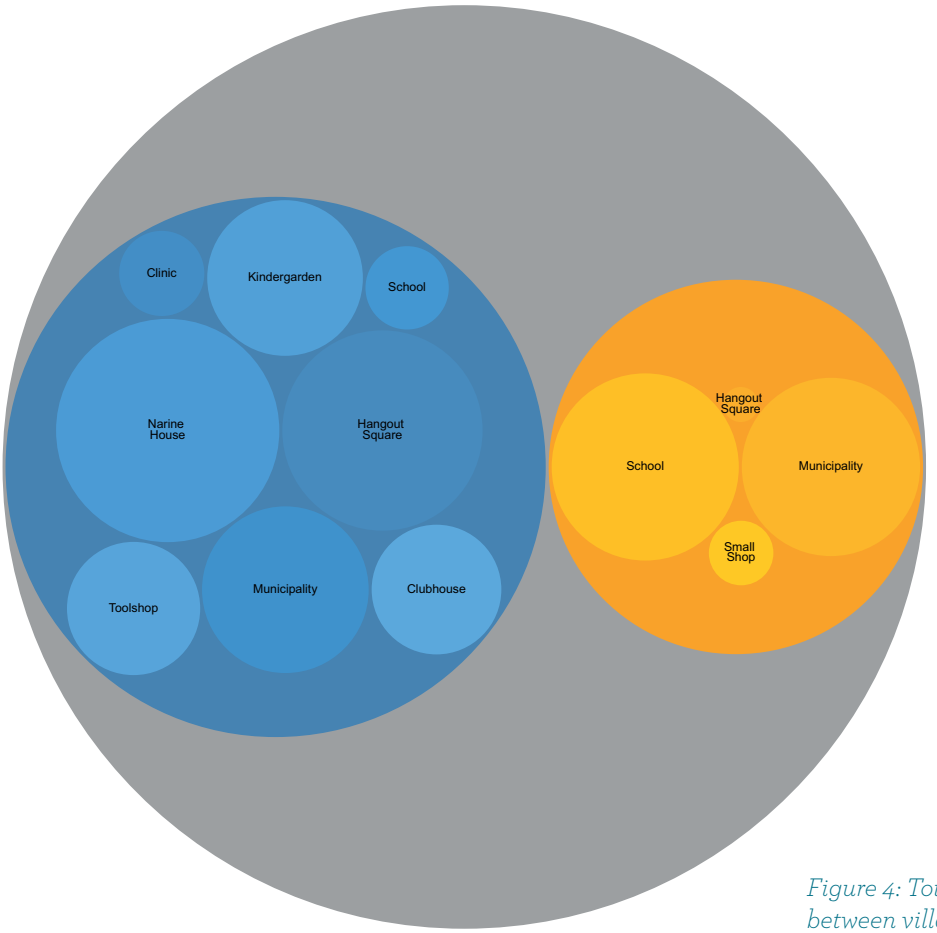


Figure 4: Total hits divided between village activity, to scale

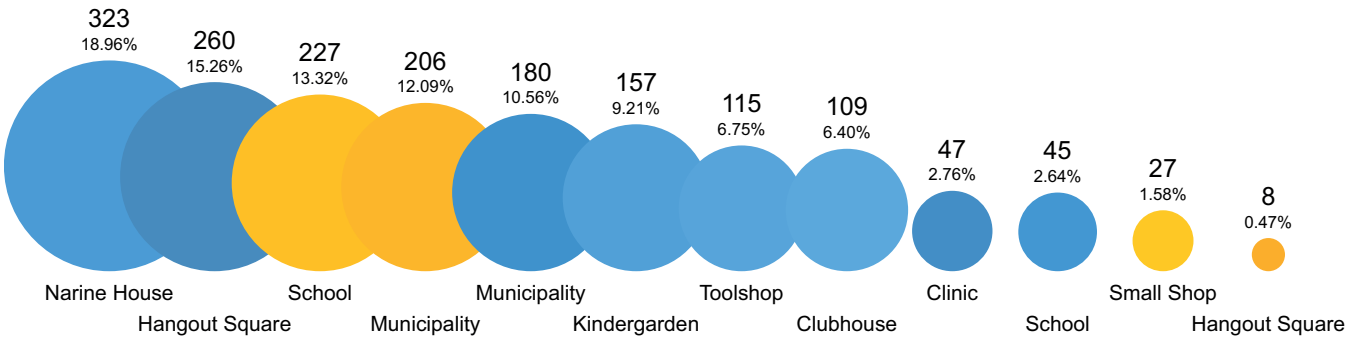


Figure 5: Restricted hits per device in descending order

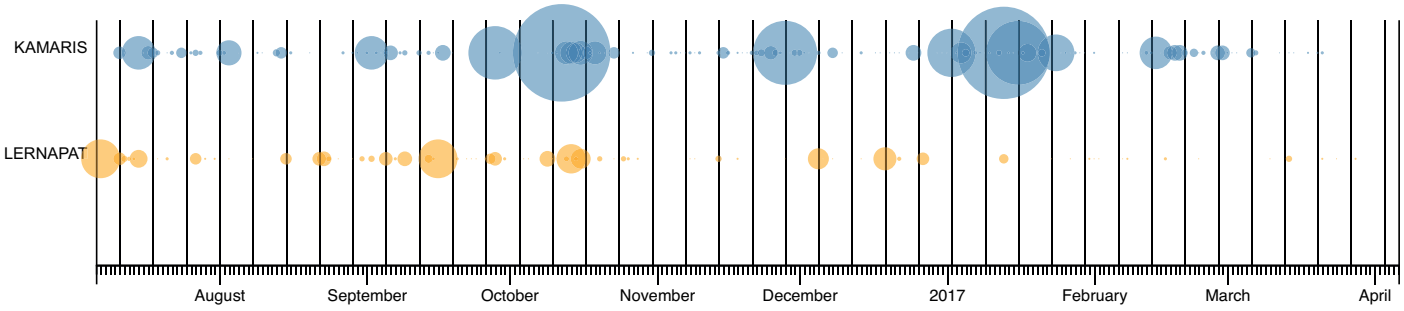


Figure 6: Activity for Kamaris and Lernapat set against time

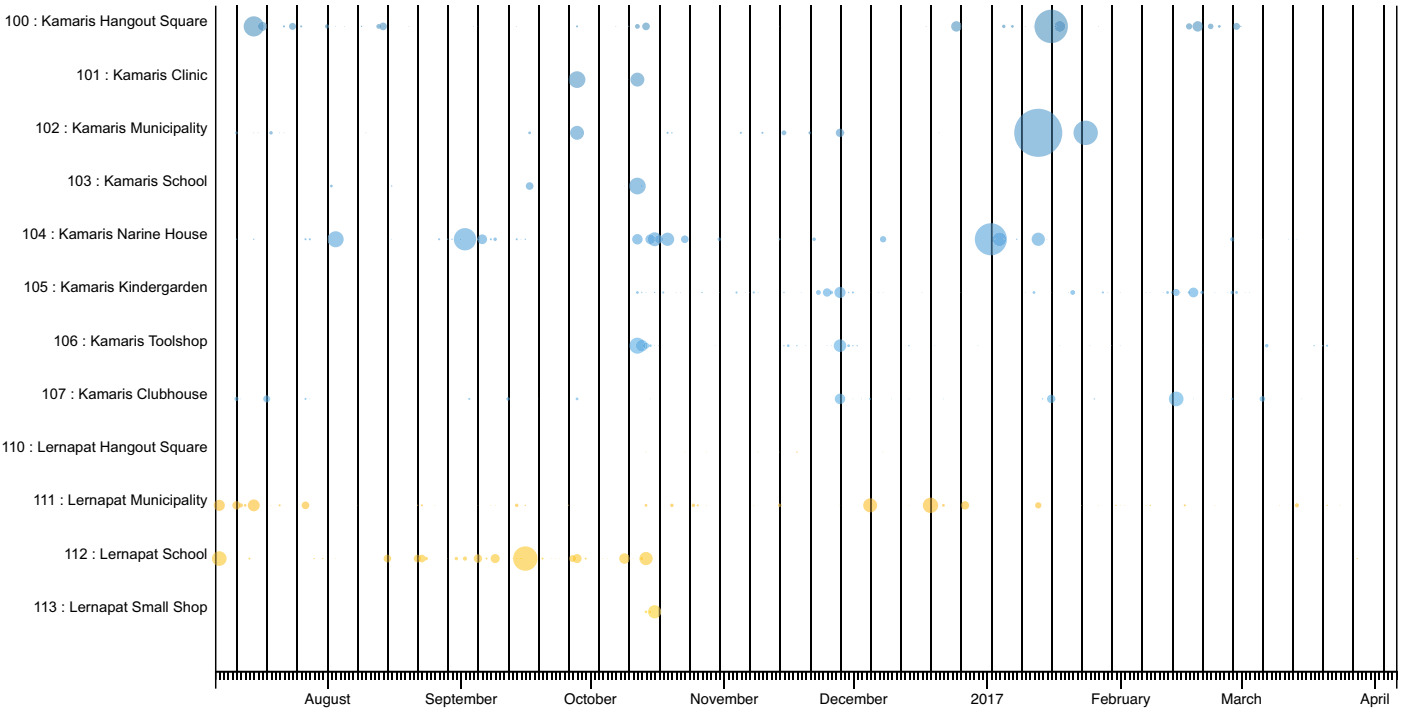


Figure 7: Restricted hits against location and time

Heatmaps built with Open Street Maps reveal restricted hits activity proportional to place (figures 8 & 9) map

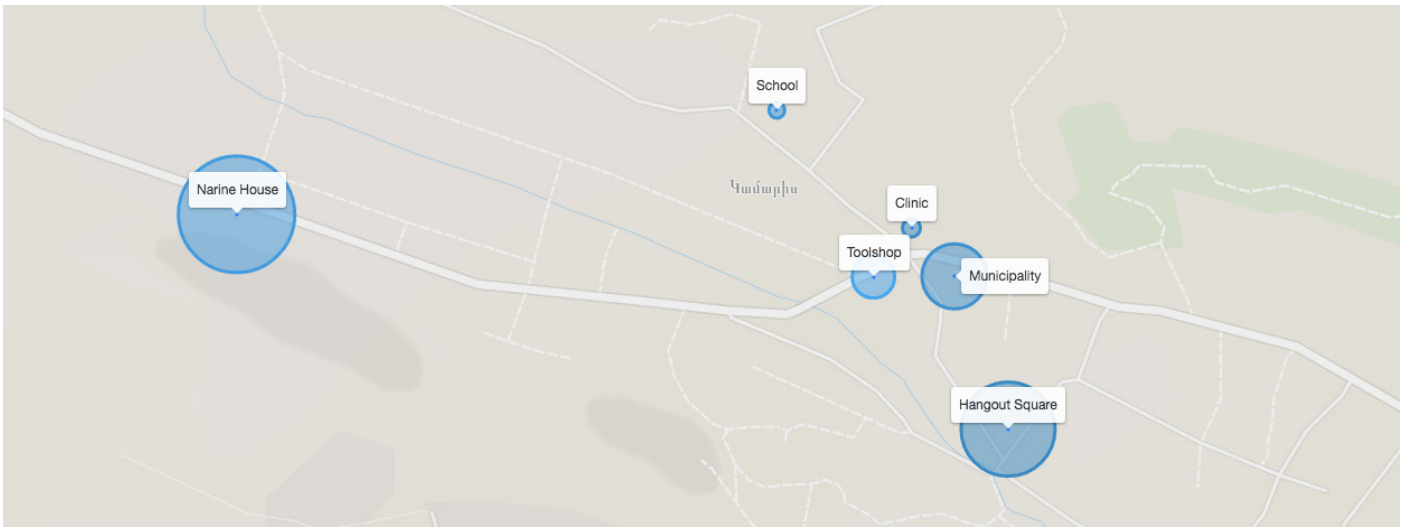


Figure 8: Lernapat restricted hits activity visualised by hyperlocality

Figure 9: Kamaris restricted hits activity visualised by hyperlocality

A unique feature of CAST is to allow the data to be further drilled to reveal which hyperlocalities were most popular by day of the week. From here it is possible to extract activity based on popular times, such as Kamaris clinic on Wednesdays (figure 10) and the municipality being consistently used (figure 11). We can see from the data that content was accessed at weekends at the small shop in Lernapat (figure 13) rather than midweek, while activity took place during the week at the school not on Saturdays when the school would likely be closed (figure 12). These insights would help publishers serve prime content based on time and hyperlocal place.

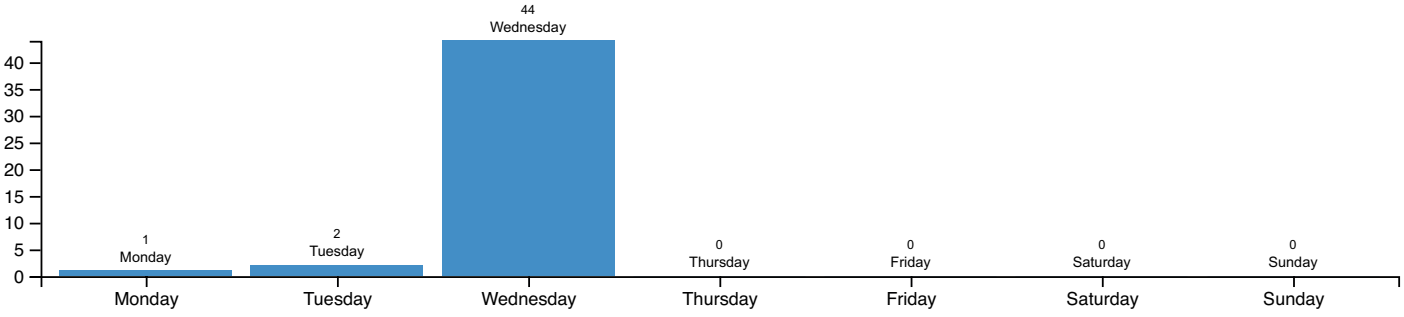


Figure 10: Kamaris clinic restricted hits weekday reveals Wednesday as a peak in activity

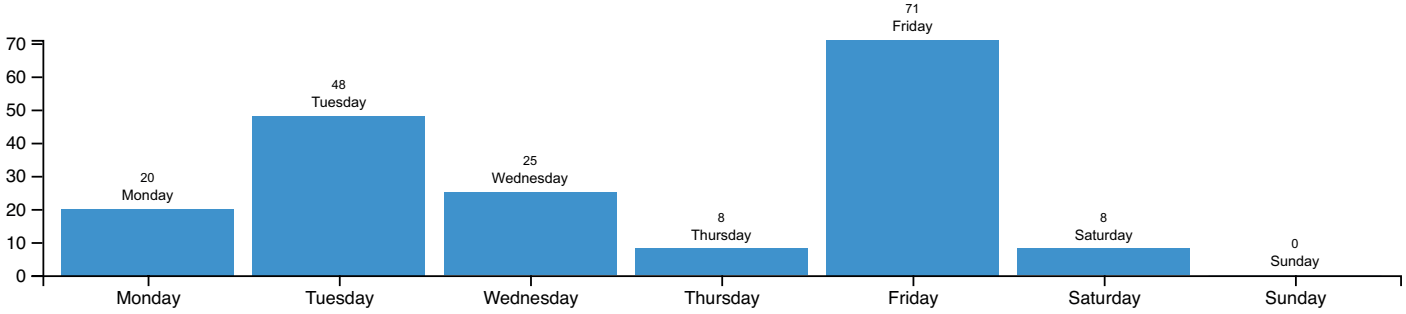


Figure 11: Kamaris municipality restricted hits weekday shows a consistent level of interaction throughout the week

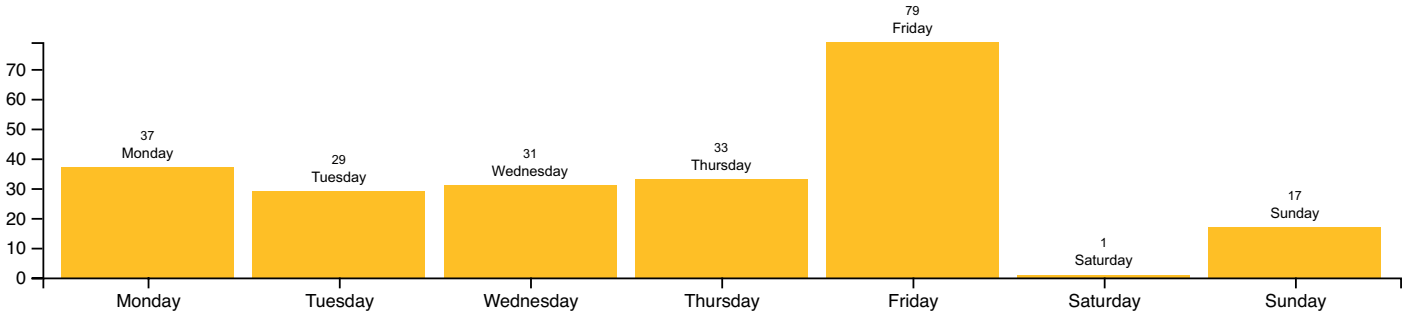


Figure 12: Lernapat school restricted hits per device shows a consistent interaction excluding Saturday when the school is likely to be shut

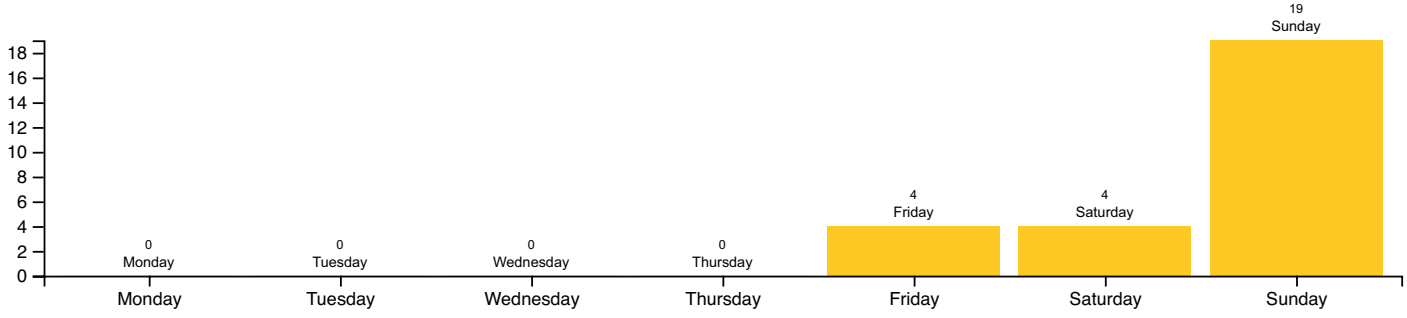


Figure 13: Lernapat small shop reveals more activity at the weekend

CAST was designed to provide data analytics based on what content was consumed to a precise location. This new form of news analytics offers hyperlocal information on what was consumed where, to the nearest device location be that a shop or bus stop. A unique feature of the CAST system was to provide content in two main ways: aggregated scraped pages from online news and information providers and original posts written by villagers on the CMS Wordpress site. The content served in (.in) represented 44.25% of the total hits activity. Posts produced by villagers themselves were more popular representing 55.75% of total activity (.be). (see figure 19)
Figure 14 presents the total activity per device in Kamaris distinguishing content from news providers (.in) and produced by villagers (.be). It is possible to conclude that the device at Kamaris Clubhouse was used most for reading community stories while news from the external providers was read more at the Municipality device. Figure 15 shows that of the four locations, external news content was read more at the school but that reading community produced stories was done most at the Small Shop.

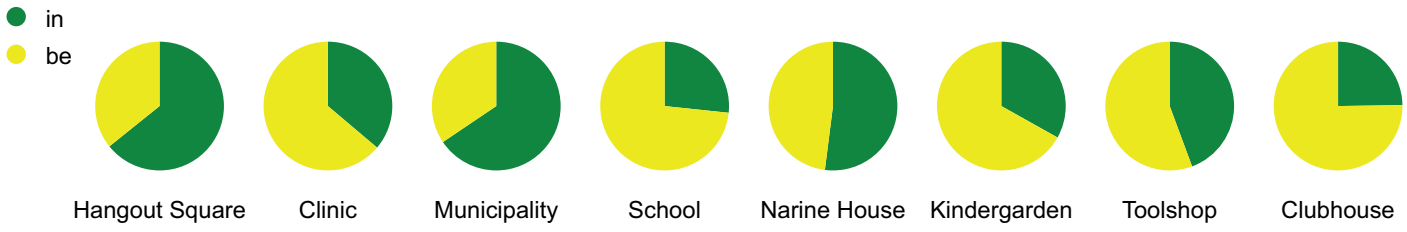


Figure 14: Kamaris device locations showing hits by type of content: domains .in and .be

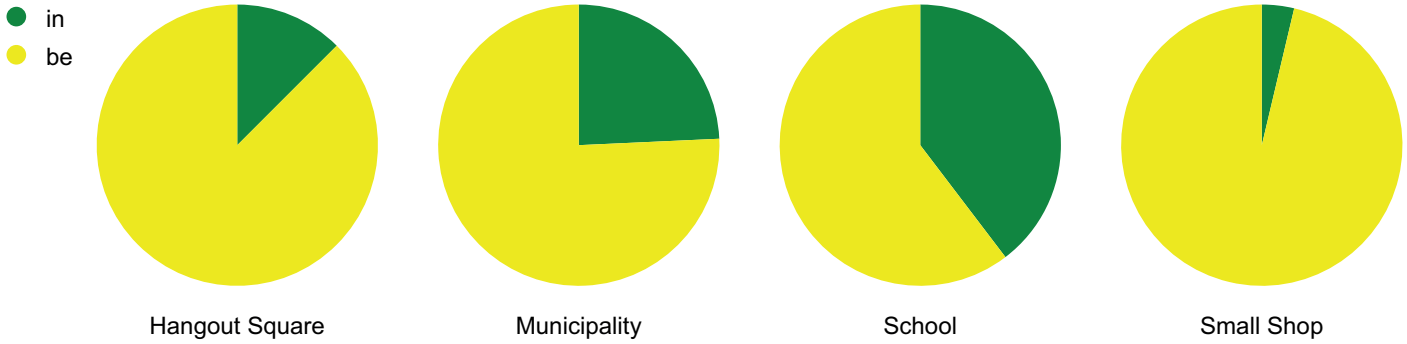


Figure 15: Lernapat device locations showing hits by type of content: domains .in and .be

Moreover figures 16 & 17 show the full potential of CAST to reveal which content provider was most popular where. Here we can see for example that Hetq was read most at devices installed at Hangout Square in both Kamaris and Lernapat. Arm Weekly News was more popular at the Lernapat school device than the municipality. Content from Arm Comedy performed best at the Municipality device in Kamaris. This new level of data analytics act as a demonstrator for a new way to serve news insights to inform editorial decisions.

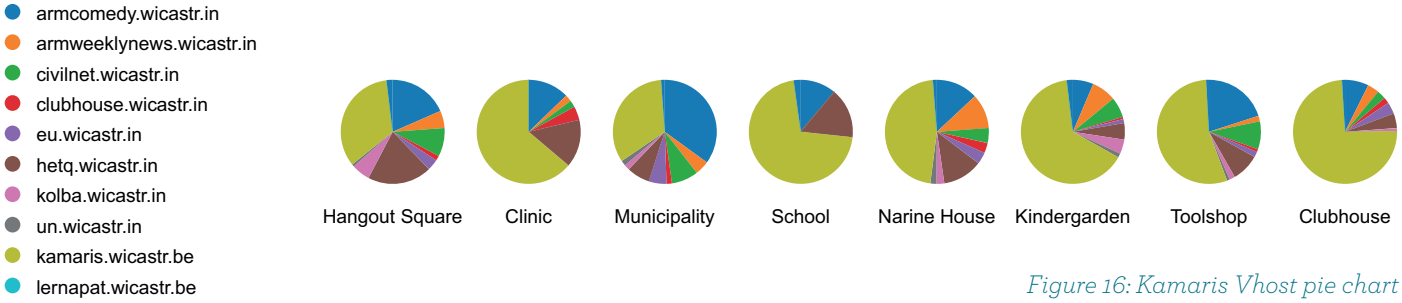


Figure 16: Kamaris Vhost pie chart

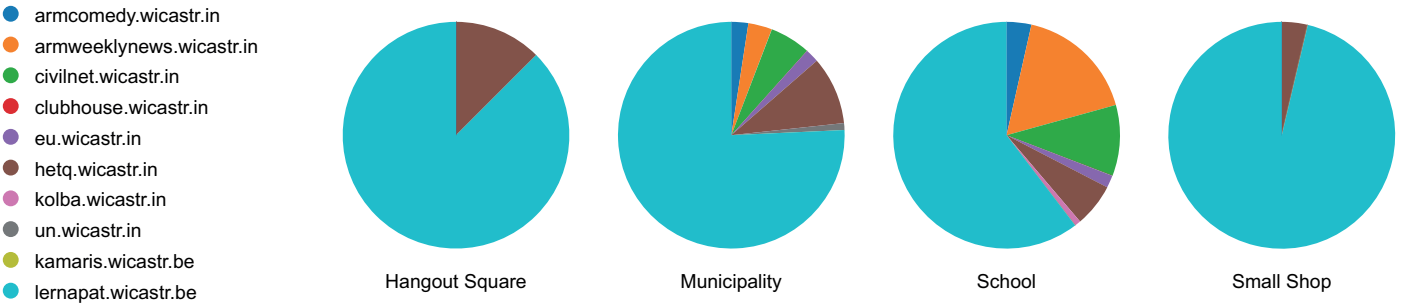


Figure 17: Lernapat v host pie chart

Tatev Abazyan, Arm Weekly News:

"During the CAST project site attendance increased by 5%. CAST project can increase audience number by providing offline accessibility to the population of the village. Statistical data are always being analysed and, due to it, changes are made accordingly. We are taking into consideration the preferences of readers, the interest of this or that material."

Hetq journalist Kristine Aghalaryan

"We need to write about them [the villagers] as well because if it is not relevant to them they will not be interested in it. We need to make important and work with them. We need to know what sort of problems they have and attract them to start reading."

Media Plurality

Initial feedback indicated that villagers had a heavy reliance on television broadcasting as a news source from programmes such as Lratvakan.am, Armenian Haykakan TV (haykakantv.com), Mamul.am and Shant TV. During interviews and focus groups all participants mentioned television as their main source of local, regional and international news. Television was described as being very user-friendly and easy-to-use option within the home and while multitasking. Few villagers sought news beyond mainstream sources and didn't see the need of finding and reading alternative news.

Project coordinator:

"They are very open minded but not tech related and it's hard for them to use it. Several indicated they do not want to hear news as they hear it on TV during the day. They don't need alternative news. They believe the news from the TV. It's old fashioned living there even the new generation are very old fashioned."

Villager

"We have a lot of daily problems and have no time to go and check news. Almost each person from out village is watching news on TV. It's more simple."

The seven sources of news and information posted to CAST were chosen as alternative to this. In doing so, CAST set out to be an actor in media plurality: as a disruptor in the provision and amplification of alternative news by providing content from independent online news sources such as Hetq or Civilnet. Table 2 shows the total number of hits across all the devices split into the news providers. This shows that of the .in aggregated content ArmComedy was the most popular followed by Arm Weekly News and Civilnet.

Content types

Most popular ArmComedy post was looked at 10 times in Kamaris (see Table 3). It was one of the chat show episodes featuring topical jokes satirising politicians and the government. The Arm Weekly News post receiving the most hits reports on the Icelandic national team winning the EURO-2016 football championship, as part of its culture section. Kolba.am best performing story was a call to action for people to join a mapping project for people living with disabilities in Armenia. The post explains how to record cafes and places that are accessible as part of the project and event. Of the Hetq stories viewed via CAST, the most viewed was a story and images by Diana Ghazaryan about a violent clash between police and a citizen claiming police beat a boy after participating in a public discussion near a supermarket. From Civilnet the most popular post was an Unplugged video jam session of musicians Michael Voskanyan and band, hosted at the Civilnet rooftop. This sample goes some way to demonstrating the diversity and civic themes of the content served during CAST.

vhost	count
armcomedy.wicastr.in	218
armweeklynews.wicastr.in	122
civilnet.wicastr.in	112
clubhouse.wicastr.in	23
eu.wicastr.in	47
hetq.wicastr.in	178
kolba.wicastr.in	38
un.wicastr.in	16
kamaris.wicastr.be	607
lernapat.wicastr.be	326
noticeboard.wicastr.be	17

Table 2: The total number of hits per site

LINK RECEIVED	NUMBER OF HITS	WEB CLIP
/armcomedy.wicastr.in/posts/147405386986a50bd5.html	10	https://www.youtube.com/watch?v=8BL-nKa-pv0
http://armcomedy.wicastr.in/posts/1473759096517 57a2a.html	9	https://www.youtube.com/watch?v=35IUbl-lkQM
http://armcomedy.wicastr.in/posts/14686520837c8ee406.html	8	https://www.youtube.com/watch?v=A3TbqlnLGZA
http://armcomedy.wicastr.in/posts/1473324564cbc2e366.html	7	https://www.youtube.com/watch?v=IrqUXClKmxE
http://armcomedy.wicastr.in/posts/1473324564cbc2e366.html	3	https://translate.google.am/translate?sl=hy&tl=en&js=y&prev=_t&hl=en&ie=UTF-8&u=http%3A%2F%2Fwww.armweeklynews.am%2Fn%2Fna%2F10%2Fa551.php&edit-text=&act=url
http://hetq.wicastr.in/posts/14691945607f1dad34.html	3	https://translate.google.am/translate?hl=en&sl=hy&tl=en&u=http%3A%2F%2Fhetq.am-2Farm%2news%2F69351%2Fosti-kannery-tsetselov-kotrel-en-ar-sen-tadevosyani-tsnoty.html

Table 3: Best performing content posts by number of hits

As part of the project we qualitatively assessed general attitudes to Armenia's news agenda and alternative information provision via eight interviews with villagers and five focus groups involving around 80 villagers, summarised in figure 18.

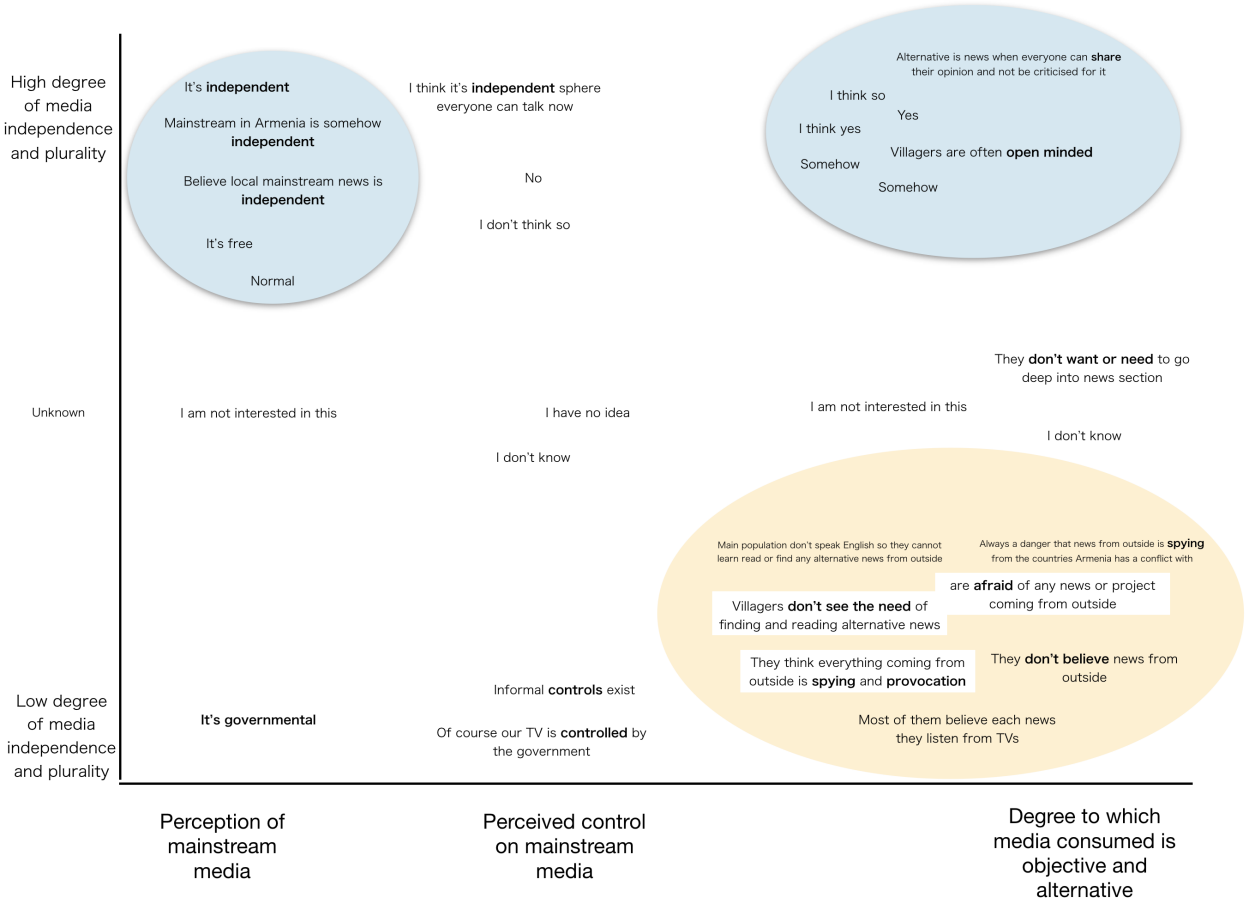


Figure 18: Feedback quotes from project participants highlighting media independence and plurality issues

Civilnet:
"It is really complicated in Armenia in terms of independent media. In terms of advertising, oligarchs own the main companies so they won't give you so you have to have other funding. We are trying to bring independent and quality and real news."

Hetq:
"TV channels are under the government. We investigate and try to combat corruption and expose wrong doings."

Teacher, Lernapat:
"Alternative news means something different than we listen from TVs"

Digital literacy and activism

A central aim of CAST was to facilitate novel approaches to digital literacy by creating hyperlocal digital communities. We set out to encourage villagers to share stories about their life and village by approved users publishing with logins to the CMS Wordpress site. The MIS team, Impact Hub and a select number of approved admin users (such as local teachers or early adopters in the communities) had a log in to the CMS. The approved admin user would first log in to Wicloud, click on the Wordpress application and then update the site/service in question via Wordpress, like one would normally do using Wordpress online (such as 'create new post' or 'upload image'). Using an open source tool such as wordpress was a way of ensuring sustainability.

Overall activity to the CMS Wordpress site hosting hyperlocal content performed better than scraped content from news providers. Total hits to the three village .be sites was 950 compared to 754 .in. (see figure 19). This indicates the appeal of content written by villagers for villagers and the potential impact of hyperlocal news agenda setting as community participants were largely left to create their own stories and themes.

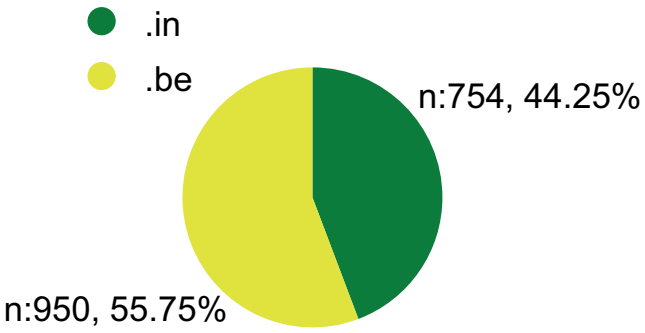


Figure 19: Restricted data comparing .in and .be posts shows content produced by villagers to be most popular

Digital literacy was improved by encouraging young people to write about their village. Lernapat (population of 2,000) engaged 12 authors and 3 editors to the site. They published more than 70 articles in categories about their village culture and sports. Kamaris and Ltchashen engaged 5 editors each. The stories ranged from local culture and heritage to photographs about daily life. Allowing posting in this way emerged community news agenda setting and the type of news to be prioritised. The My Village Kamaris and My Village Lernapat pages were visited 50 and 27 times respectively. Other popular pages were in the categories of school, education, culture and famous people in which posts celebrated local heritage and activities.

Teacher, Lernapat:

"When you need to look up a news it's easy because there is no need to turn on or find any other internet connection"

Data Management Plan

While a user is connected to the network the WICASTR™ device logs all of the usage data that can usually be found in regular analytics services such as Google analytics. All critical data capture elements of the cloud service were not directly accessible from the web and were hidden inside a local network. There were two cloud services. The distinction is between the local cloud and the online one:
- local cloud (device and network on the ground)
- Wicloud infrastructure online: where the networks, devices and content management is managed, as well as access to network data.

CAST data management operated such that the devices gathered data (local Cloud networks), and periodically synced the data, via encryption, to Wicloud (online cloud) for the project researchers to access via an interface - from which data could be exported. On a frequent basis CAST can transfer data from devices in villages (the local cloud) to the Wicloud (the online cloud), and from there the technology lead from the team can log on to see the data online (in the MySQL database), and export the data to a host datastore via CSV file. Once exported, it can be removed from the WiCloud servers. However in our trial, the system had to be manually overridden and data brought in physically by connecting to each device in location. Due to the remoteness of villages, a member of the team approached the device with any WIFI enabled laptop/android based smart device and connected via WiFi while in proximity, and could then transfer the data to the device, and eventually send it to the WICASTR™ cloud or the project team directly.

In capturing location metrics, mobile device information was hashed in real time before being logged on the WICASTR™ device and eventually sent to the cloud service. The hashing is different per user/network/project/location to avoid crosscheck between databases that would allow tracking at a large scale. Once connected, that's when the usage metrics started (page views, time spent on page etc). And if via a consent form, a mobile user registered personal data (name, email, phone number), we could start sending notifications to them as they are detected by a WICASTR™ device or network if there was constant connectivity.

There was no need to signup to any ISPN terms, since we were not providing Internet connectivity. In mesh formation, the Internet connectivity would only be used to sync local data to Wicloud, and update and provision the local WICASTR™ devices and local network with new content or web services. CAST did not provide Internet connectivity at large.

The WICASTR™ hardware itself came with security features that allowed for users' keys and data safety in case a device was stolen. All critical data on the device was encrypted following TKS1 (an anti-forensic, two level, and iterated key setup scheme) secure key setup scheme. All communications from the devices to the cloud service were authenticated and encrypted using either SSH (Secure Shell), SSL (Secure Sockets Layer), HMAC-SHA256 (Keyed-Hash message Authentication Code) depending on the type of communication. Virtual Private Networks (VPN's) can be implemented to further improve the protection of circulating data. All critical elements of the cloud service were not directly accessible from the web and were hidden inside a local network. The distribution of applications is authenticated and encrypted via 2048 bits RSA (Rivest-Shamir-Adleman) keys and privately signed for each user with PGP (Pretty Good Privacy).

Overcoming a digital divide

Digital literacy was a key hurdle to the deployment of CAST as the villages selected were remote and digital literacy was low among many. In a scoping meeting in March 2016 one villager asked if CAST would 'spy on them'. There were also concerns about lack of control in that an open access anonymous digital noticeboard would allow people to write 'bad things' about one another. In one village the team faced resistance in one of the shops as one person was worried about WiFi radiation. In December, the project coordinator noted a feeling that CAST was 'foreign'. The older population of the villages had limited digital literacy particularly around smartphones, which meant they couldn't access the website.

Village comments
"Each time I am forgetting how to enter to the page."
"I didn't use it actually. I just tried to enter and got nervous so decided to not continue."
"I didn't like it, because it is news related only and I don't like to read news that much."
"It would be good for the people who sits at home and have nothing to do, but I think they will prefer to use TV for getting news."

Our aim was to promote the awareness of data capture and management. This was done via a series of visualisations on the local cloud (hosted on the local CMS) so that communities could better understand what data was collected about them. In a section of the site 'The Project' detailed data, information, consent and code of conduct information were available. This explained what data was being collected and why, and terms of use. It was important this was informative but did not deter users from engaging with the experience, particularly where digital literacy may be low. The form was built in html and available in Armenian and English. Adapted consent forms were also circulated for young people. This information was also available in a pamphlet or in printed form in village locations.

Sustainability was built into the project by using low-cost, open-source technology Wordpress and providing open access training and toolkits. These covered journalism skills, storytelling, editing and upload processes to the CMS.

Community outreach activities in schools and village halls

Zarzand Yegoryan, mayor of Kamaris, said:
"We are very excited to have this technology in the villages. The technology will really improve our lives and encourage people to think about a more digital future."

SECTION FOUR
Conclusions

Key Findings

26 devices were installed in three villages. Locations included schools, health-care centres, bus stops and village meeting spots. The total sample of hits to all devices was 120,077 (82,431 in Kamaris compared to 37,646 in Lernapat.) Once restricted to grounded data, the total number of visitors to the two villages was 485.

In total, 269,836 calls were originally logged to the devices. However once duplicates, foreign IPs, invalid requests and other errors were accounted for the total sample of usable data was 1,704. This represents the total number of pages served.

In total between June - December 2016 from seven participating news and information providers, 4938 articles were served, 520 videos, and 12,521 images totalling 22GB of data. Wikimedia was provided as an offline static resource on the devices.

34 training visits, installation or meeting dates were held in the villages but a permanent project representative or trainer in the village would have been more effective to maximise impact and learning. Community projects of this nature need local representatives and consistent training over sustained periods.

Digital literacy was developed by encouraging young people to write about their village. Lernapat (population of 2,000) engaged 12 authors and 3 editors to the site. They published more than 70 articles in categories about their village culture and sports. Kamaris and Ltchashen engaged 5 editors each.

Overall activity to the CMS Wordpress hosting hyperlocal content produced by the community performed better than scraped content from news providers. Total hits to the three village .be sites was 950 compared to 754 .in.

The CAST system can increase audience numbers by providing offline accessibility to the population of the village. One news provider Arm Weekly News reported: “During the CAST project site attendance increased by 5%.”

The overall deployment of WICASTR™ devices was insufficient to offer adequate coverage or to trial CAST in a mesh formation. The pilot thus stopped short of offering an effective alternative to online experiences in any one village.

Mobile Internet connectivity remains a major issue in remote places. Even the CAST system required some connectivity and this was inconsistent.

CAST can transfer data from devices in villages (the local cloud) to the Wicloud (the online cloud), and from there a technology lead can log on to see the data online (in the MySQL database), and export the data to a host datastore via CSV file. Once exported, it can be removed from the WiCloud servers.

However in our trial, the system had to be manually overridden and data brought in physically by connecting to each device in location.

Online to offline systems which cannot rely on services provided by the technology giants need bespoke analytics and these should be put in place from the start.

Where some Internet connectivity is available albeit slow or fixed location this detracts from the value of village-only networks. CAST further evidences the stranglehold of the Internet social media giants such as Facebook.

User design must be central to any community-facing interface as this can be an immediate barrier to engagement.

Digital habits are such that on-demand and constantly refreshed sites have been normalised and there is an expectation for regular updates on a project offering news and information.

Digital literacy was low among many user groups and there was much confusion around data management, privacy and capture. CAST went some way to informing citizens about personal data but much more needs to be done.

Key Learnings

Lack of interest in local news

Any project related to hyperlocal community connectivity needs to engage fully with its community. There was reticence in the villages that they had no need to share what was going on digitally as word of mouth was quick and easy.

Thirst for daily updates

Feedback highlighted the need for regular updates with criticism that 'news were old'. Active users were keen to discover new updates, pages and stories. One villager said: "News are not being updated on daily bases and that's why they are getting old and not interesting for local population."

User design

The project had limited resources for user design and those interacting with it found it "very hard to access to the website" saying the "interface is not nice and it has no interactive part in it". A lack of background information on browser and operating systems hindered this process. As was, on some devices navigation was poor and not user-friendly.

Local representative

At least one person from each village should be recruited and paid accordingly, to become the bridge between the village and the managers of the project. As well as acting as the go-to person to make sure everything works properly, troubleshooting the devices and repair was also needed.

Difficult to compete with major social networks

Like young people around the globe, villagers mainly preferred using Internet access for their personal networking, chat apps, video interactions and gaming. They were more likely to use the Internet at home for Facebook and other social media such as Odnoklassniki (Ok.ru) and vk.com and discover news via recommendations. Instagram and Twitter were used little according to focus groups. This project goes some way to evidence the stranglehold of the Internet's social media giants where, even in remote locations with poor and expensive Internet connectivity, community preference is to go up to Facebook or other social media for interactions which transcend geographic borders.

Local government influence

It was hard to assess whether the absence or involvement of local government officials influenced the adoption of CAST. Saying this, CAST tried to work with villages' mayors and the municipality for credibility. In October 2016 feedback was noted: "In Armenia there is a mentality that if it is free they don't care. But if they were paying they would be more interested. If they see it as paid for by municipality they think it's coming out of their pockets even just to see it is interesting or not. If the mayor's office is aware and actively supporting it that could be interesting."

Amplification of alternative news

One news provider, Arm Weekly News reported an increase in traffic by 5% during the CAST pilot. Of the information served from official providers, ArmComedy was the most popular content. While other factors could account for this increase, it goes some way to demonstrate the potential impact CAST could have. Data analytics on users and traffic from other news providers also lack the pinpointing capabilities offered from CAST. The project stops short of being able to assess whether the availability of this alternative content impacted on community opinions or a broader civil society agenda.

Operational barriers

In all three locations weather and project timings were a challenge. During several months temperatures dropped to -30C at which mobile phones do not work consistently due to battery failure. The project was extended to allow further pilot phases. However equally, during the summer months when students were not at school there was less community drive. This goes some way to explain lower interaction levels. The project team also faced significant challenges attempting to work and translate into Armenian.

Coverage

CAST coverage was insufficient in any one village. The project needed more access points all around a village to offer more blanket coverage. More extensive coverage to include homes, bus stops, streets and municipality buildings was needed to allow a mesh formation trial.

Hardware issues

From being involved in CAST, WICASTR™ has developed the hardware - an enclosure dedicated for outdoor use, which can be completely closed and without any externally accessible parts. Unfortunately, the way the first enclosure was designed there was easy access to: SIM card, micro SD card (16/32gig) and the power supply which looked like normal USB mobile device chargers. In some instances elements of the structure were stolen because of physical access to them. Therefore the outdoor enclosure was in fact necessary even for indoor installation to avoid such problems. The project needed a technician on hand in the villagers to ensure access point status.

Existing internet access

As villagers had some Internet access, usually from their homes via one fixed-point computer they preferred to default there for news and information. This was said to be more up to date. One said " We have Internet at home and I get everything I need from there".

Data analytics

CAST had at its core important learning as it required robust data analysis away from those offered online by the global technology giants. Given that such online to offline analytics has no off-the-shelf plug in, a robust analytics platform needed to be in place from the start. Tracking an offline device needs careful planning as apache logs had limited scope.

Connectivity issues

Because of the geographic configuration of the selected villages (mainly size of village and location of dense populated areas) and insufficient budget, the initial idea of having mesh networking capabilities where one or two gateway devices per village would be connected to the Internet did not materialize. As such, to overcome this situation a combination of extra SIM card (mobile data plan) had to be used, almost one per device, and a few long range antennas were equally deployed, which added to costs. That being said, the main connectivity problem in these village locations were associated to inadequate and/or inconsistent coverage by one or all of the three local telcos (Beeline, UCOM or VIVACELL). From experience and reputation, VIVACELL is known to have the best coverage in Armenia, including in remote areas. Even though coverage maps provided by the three local telcos showcased proper coverage because of reputation, we opted to get data SIM cards from VIVACELL. However once in the villages we found out that the quality of connectivity was limited. We used multiple vendors to try and achieve the best coverage possible. This was discovered by trial and error, and required testing to be done on location to verify signal strength and quality. Even with that, the coverage was temperamental. Only a few devices had proper/consistent connectivity, and the majority of the devices would have temperamental connectivity.

Sharing economy

Where Internet connectivity is an issue due to cost, a deeper understanding should be shown for the capacity of the sharing economy. An exchange system could have been developed for content posting, paying for electricity or Internet charges.

Iterations and trajectory

This project has offered a rare empirical insight into the possibilities of lightweight, online-to-offline community communication systems. However the exploratory nature of this pilot meant that it identified many areas for further research.

These would include:

A follow-up study using a comparative approach between news disseminated via Web Applications, Beacons and WiFi typologies, geofencing, narrowcasting, Near Field Communication (NFC), Global Positioning Systems (GPS), Radio Frequency Identification (RFID) and SMS to explore new mix-and-match ways of discovering essential information for civic engagement based on hyperlocality. This would allow a greater understanding of the unique characteristics of each distribution system, and their value to both publishers and audiences.

Testing the CAST system as a mesh formation. The project's capacity stopped short of testing the WICASTR™ devices as a collective that can form a mesh. One device connects to the Internet which receives real time content and information, which is then distributed amongst all other devices within its network. This would be pivotal to the capacity of CAST as a 'pop up' network in disaster or crisis situations. It also leverages unique features such as pinning content to place for other users to discover, and being able to fully control content in hyperlocality - what is seen or hidden from one device, village or mesh to another.

Further research on content popularity based on place. While this study highlights new specificities around what content is consumed where it stops short of offering rationale for why. An ability to understand why content is more popular based on location would further enable news providers to offer better user experiences.

Taking things further, the concept of data capture close to the network edge could be enhanced with machine learning. This approach would use computing power on the devices locally, to understand instantly what is needed at the location, even why, content wise, and then use an online service to match it with subscribed third party content providers, to publish content at the location. Further insights from the blockchain could assist in this and open up opportunities for remuneration. This is an entirely new model to be explored at scale.

Issues relating to content amplification and discovery are not limited to remote regions. Publishers, particularly of local news media, need new interesting ways to deliver content to mobile audiences. By setting out how this system was designed, built and deployed we emerge a new living media concept for content amplification fit for future smart cities.

Emerging new revenue models for news publishers and the community based on accurate location data. These new modes of place-based distribution also offer significant new scope for revenue streams, beyond advertising, such as digital placemaking, active citizenship nudges paid on commission, to convert passing footfall and increased revenues from pinpointed content and opening up new audiences and driving traffic. The system can also harness new sharing economy cost-saving benefits to communities alongside existing approaches such as offers and advertising. Further insights into the unique possibilities for revenue generation in politically pressured environments, where revenue generation for alternative or independent news media is challenging, would be of particular value.

Responding to user feedback in the villages to make the experience more frictionless and serve their needs better. This includes design features and installing more devices to improve coverage. Co-design and co-creation methodologies or rapid build environments such as Hackathons would be used to ensure systems are fit for purpose.

Develop the CAST tools envisaged in collaboration with the community such as movie streaming, games, SMS to noticeboard function, surveys and polls, location-based learning resources, uploading images and rich media direct from mobile, collaborative document editing, save and search functions. Future iterations would include testing the noticeboard fully.

There are significant ethical and policy implications arising from this trial. What more should be done to explain data capture and tracking? How can we offer sufficient protection for minors? Current direct marketing and advertising laws stop short of specifying guidelines for proximity broadcasting.

In a larger sense, a more detailed study could shed light on user engagement which is a complex and multidimensional construct entangled with a variety of factors, such as timeliness, cultural setting, technology and novelty. This would add to the body of research on spatial journalism.

Developing the knowledge base around journalistic practice for location-based distribution. If we can establish what content is popular where, a next step would be to explore how we can better write and produce journalistically taking locative preferences into account.

A more nuanced research methodology to assess how place-based news delivery can act as a tool for civil society and media plurality. There was not space within this pilot to fully explore the news consumption habits of the village community members and thus assess or measure the impact CAST had on serving alternative or politically neutral news and information to the community.

Harnessing the CAST system as an offline to online payment system

Further Resources

With thanks to

Professor Paul Egglestone, University of Newcastle, Australia
The communities of Lernapat, Ltchashen and Kamaris

Further resources

Project documentary
https://youtu.be/P9vyJ7IpSeE
Project explanation and interview with That's Lancashire
https://youtu.be/o5Gss-qXMAQ
Twitter
@CASTprj
WICASTR SMART Edge Platform
https://wicastr.com/

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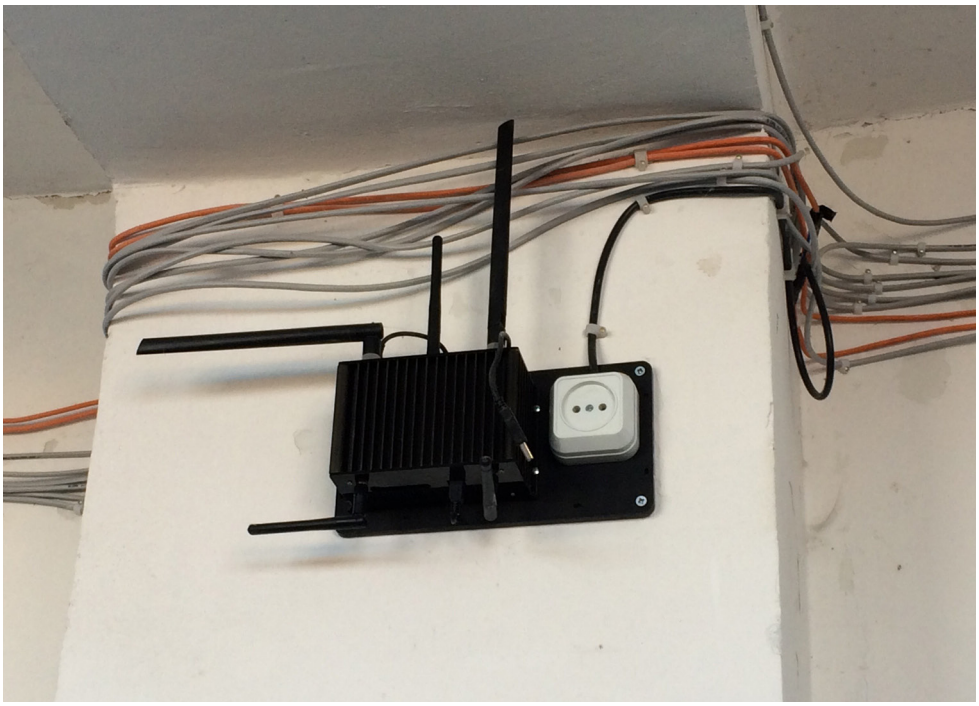


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